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Introduction

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Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics, and 33 Thermodynamics and Combustion. 3363

02 AIRCRAFT
Includes fixed-wing aircraft, helicopters, gliders, balloons, ornithopters, etc., and specific types of composite aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles, and 32 Structural Mechanics. 3366

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07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; radiation telemetry; tracking (radar and optical observation) and wave propagation. For basic research see: 23 Physics, General, and 21 Navigation. 3398

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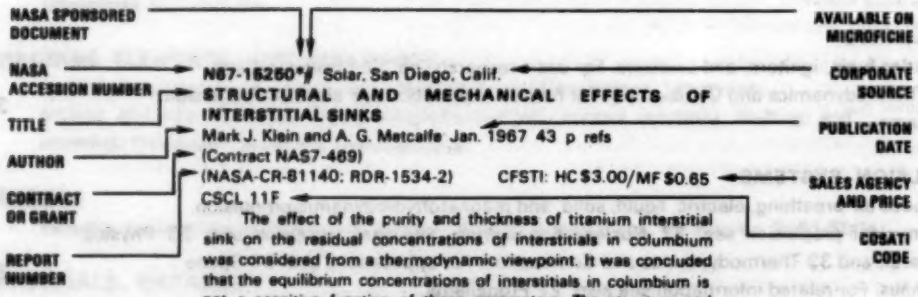
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The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples ware correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

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N67-32791# Bureau d'Analyse et de Recherche Appliquees, Boulogne-Billancourt (France).

APPLICATION OF THE LIFTING FOIL THEORY SOLVED BY RHEOELECTRIC ANALOGY TO THE CALCULATION AND DESIGN OF SUB- AND SUPER-CAVITATING PROPELLERS Final Report

L. Malavard and P. Sulmont Mar. 1967 53 p refs

(Contract N62558-4998)

(AD-652981) CFSTI: HC $3.00/MF $0.65

The first part of the report is devoted to the calculation of a conventional type propeller operating under sub-cavitating conditions, and to the results of experimental tank tests carried out on a model developed from the results of these calculations. The second part deals with the theory and calculation of a super-cavitating propeller designed for a cavitation tunnel test. Author (TAB)

N67-32872# Aerophysics Co., Washington, D. C.

AERODYNAMIC TESTING OF AN AIRBORNE LIGHTWEIGHT HIGH-EFFICIENCY RADIAL FAN

William F. Foshag, Homer Ray, and Gabriel D. Boehler Mar. 1967 38 p refs

(Contract DA-44-177-AMC-454(T))

(USAAVLABS-TR-67-20; AD-652725) CFSTI: HC $3.00/MF $0.65

The results of the aerodynamic testing of a 66-inch diameter rotating-diffuser centrifugal fan for internal flow airborne applications are presented. To accommodate the testing of this unit, a testing facility had to be designed and built. Because of the availability of a test pad and high-power variable frequency electric motor equipment, the facility was located on the grounds of the Aerodynamics Laboratory of the U. S. Navy David Taylor Model Basin. The test stand and its calibration are described, and the results are presented. Results of the tests indicate a peak total pressure efficiency of 85 percent. This correlates with model fan information, including an experimentally determined scale effect. The RD fan is thus found to be an efficient, robust, stable air mover for air cushion vehicles and for other lightweight airborne applications. A limited noise survey investigation was made. It indicated low noise levels for the RD fan. Author (TAB)

N67-33116# Ballistic Research Labs., Aberdeen Proving Ground, Md.

NONLINEAR MOTION OF A SYMMETRIC MISSILE ACTED ON BY A DOUBLE-VALUED STATIC MOMENT

C. H. Murphy Feb. 1967 32 p refs

(BRL-MR-1823; AD-652095) CFSTI: HC $3.00/MF $0.65

The static moment of a symmetric missile is usually assumed to be single-valued although double-valued moments can occur: for example, a missile with a separated flow field. The quasi-linear analysis is generalized to treat the motion of a missile with a relatively simple double-valued static moment and cubic damping moments. The associated amplitude plane is discussed and the special case of planar motion is examined in detail. The quasi-linear frequency and damping are compared with exact values and conditions for the existence of planar limit cycles are stated. Author (TAB)

N67-33367*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

SIMULATION EXPERIMENTS FOR JET INTERACTION

J. L. Amick (Michigan Univ., Ann Arbor) *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Two simulators were built to facilitate experimental studies of the two-dimensional interaction of a jet with supersonic free stream. Preliminary tests were made in a jet-turning simulator, which uses an inclined plate in place of the deflected free stream and part of the separated flow upstream of a dividing streamline. Typical flow patterns of a complete interaction are indicated by a schlieren photograph; and pressure measurements along the inclined plate show a sharp pressure peak that is taken to be a stagnation point, which corresponds to the effective step height of the jet. While these height values agree qualitatively with circular-arc jet theory, it is noted that the jet used is sonic and highly under-expanded. M.W.R.

N67-33368*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

PLANAR CONFIGURATION STUDY

H. H. Hart *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Dorsal-finned, delta-winged, and dart-winged configurations were investigated by wind tunnel testing and semi-empirical correlation of test results; and the lateral and directional characteristics of these volume-limited missile configurations were found to be dominated by interference effects. Optimization studies, culminating in the dart-winged design, were made at Mach 2.5 and 3.5; and good agreement for experimental and predicted results was found for this design. M.W.R.

N67-33376*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MIXING DEVICES FOR DELAYING SEPARATION
R. H. Cramer *In its* Res. and Develop. Programs Mar. 1967 2 p ref (See N67-33361 19-34)

Separation phenomena and means of combatting deterioration in aerodynamic performance due to these unwanted flow detachments are being studied in 6×7-foot high speed wind tunnel. Drag coefficient versus aspect ratio vane-type mixing devices was determined for 24 configurations, all at 5-deg angle of attack. Data for both rectangular and delta-wing shapes are graphed; and raked-tip vanes were also tested. Plots indicate that vanes that extend farther out into the non-debilitated flow have smaller drag coefficients for a fixed aspect ratio. When two vanes with fixed chord are compared, the longer span model has a slightly higher drag coefficient. Such trends are explainable if the leading edge drag is the overwhelming contributor to the total drag. M.W.R.

N67-33439# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Aerodynamik.
THEORETICAL ESTIMATION OF THE AERODYNAMIC DERIVATIVES FOR ARROWHEAD AND DELTA WINGS DESCRIBING PITCHING OSCILLATIONS [THEORETISCHE BESTIMMUNG INSTATIONAERER FLUGMECHANISCHER DERIVATIVA DER NICKSCHWINGUNG VON PFEIL- UND DELTAFLUEGELN]
H. Otto Mar. 1967 69 p refs In GERMAN; ENGLISH summary Supported in part by Deutsche Forschungsgemeinschaft (DLR-FB-67-26; Rept.-65/11)

The aerodynamic lift and moment derivatives for pitching oscillations in incompressible flow have been calculated by the theory of H.C. Garner for swept wings of the aspect ratios $\Lambda = 0.6$; 1; 2; 4; 6, the taper ratios $\lambda = 0$; 0.25; 0.5; 0.75; 1, and the angles of sweetback of the leading edges $\alpha_v = 0°$; 15°; 30°; 45°; 60° and 75°. The pitching derivatives were also calculated for delta wings of the same aspect ratios and taper ratios. The results are represented in diagrams and tables. The calculated values are compared with experimental results available from the literature and show good agreement. Author

N67-33443*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF A SPHERICALLY BLUNTED 25° CONE AT A MACH NUMBER OF 20
Julius E. Harris Washington, NASA, Aug. 1967 23 p refs (NASA-TN-D-4098) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experimental investigation has been conducted in nitrogen to determine the static longitudinal aerodynamic characteristics and the pressure distributions for a spherically blunted cone with a 25° semiapex angle. The bluntness ratio of the configuration, defined as the ratio of nose radius to base radius, was 0.2. The tests were made in the hotshot tunnel at a Mach number of approximately 20 and a Reynolds number of 0.15×10^6. Static longitudinal-stability data and pressure-distribution data were obtained over angle-of-attack ranges of 0° to 30° and 0° to 15°, respectively. Analysis of the data indicated that the configuration was statically stable for a center of gravity at the centroid of the planform area. Estimates of the force and moment coefficients obtained by using modified Newtonian impact theory agreed well with experimental results over the angle-of-attack range. Pressure coefficients estimated by using modified Newtonian impact theory were in good agreement with those obtained on the spherical nose but were less than those obtained on the conical portion of the configuration. Predictions with tangent-cone theory of the conical pressure coefficients agreed well with the experimental data. Author

N67-33876*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS OF THREE AXISYMMETRIC LOW-FINENESS-RATIO REENTRY SHAPES AT MACH 6.9
Jim. A. Penland and Peter T. Bernot Washington, NASA, Aug. 1967 35 p refs (NASA-TN-D-4122) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experimental investigation has been conducted to determine the force, stability, and control characteristics of three low-fineness-ratio axisymmetric reentry shapes at a Mach number of 6.9 and a Reynolds number based on body length of 0.98×10^6. Analysis of the data indicates that trim may be accomplished by the use of trailing-edge flap controls and that a wide trim angle-of-attack range may be provided by a downward shift of the center of gravity. With moderate afterbody alteration and appropriate center-of-gravity location, an axisymmetric body may be made self-trimming. Newtonian theory for the basic bodies without controls provided good estimates of normal force, pitching moment, and center-of-pressure location but optimistic estimates of maximum lift-drag ratio. Author

N67-33973# Lockheed-Georgia Co., Marietta. Aerospace Sciences Lab.
VELOCITY DISTRIBUTIONS OVER THE SURFACE OF A SYMMETRICAL CIRCULAR ARC AIRFOIL AT SUBSONIC SPEEDS
Saburo Asaka and Nisiki Hayasi Dec. 1966 82 p refs (LGR-ER-8841; AD-813061) CFSTI: HC $3.00/MF $0.65

The thin-airfoil theory is one of the most convenient and accurate methods for calculating the flow of an inviscid compressible fluid past an airfoil, but it is unreliable in regions near sharp edges. For sharp-edged profiles at zero angle of attack, this defect may be almost removed by proper choice of the coordinate. From this point of view, the flow of a compressible fluid past a symmetrical circular arc airfoil at zero angle of attack was reinvestigated, and the formulas for calculating the velocity distribution over the surface of the airfoil were obtained. These formulas are uniformly valid for the region near the stagnation points as well as for the mid-chord region for incompressible flows. These formulas have been programmed for use on an IBM 360/50 computer. The velocity distributions over the surface of the airfoils of various thickness ratios and for various free-stream Mach numbers have been calculated and presented in tables and figures for ready use. It was found that the present formulas give reliable values of velocity near and at the stagnation points as well as for the high speed region at almost all subcritical Mach numbers. Close examinations, however, revelaed that a slight singularity remained near the stagnation points for high Mach numbers. Author (TAB)

N67-33995*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF CONFIGURATION MODIFICATIONS ON AERODYNAMIC CHARACTERISTICS OF TENSION SHELL SHAPES AT MACH 3.0
James Wayne Sawyer and William D. Deveikis Washington, NASA, Aug. 1967 38 p refs (NASA-TN-D-4080) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation was conducted at a Mach number of 3.0 to determine the effectiveness of configuration modifications applied at the base of tension shell-shaped models in delaying the onset of flow separation and thus improving the resultant aerodynamic characteristics. Three configurations were modified by systematically reducing the base radius in 5-percent increments to 80 percent of the original radius while maintaining a corner radius at the base of either 0 or 5 percent of the original base radius. The tests were conducted at angles of attack from 0° to 12° and at Reynolds numbers, based on maximum base diameter, of approximately

1.0×10^6 and 3.0×10^6. Reducing the base radius and increasing the corner radius delayed flow separation to higher angles of attack and significantly improved static stability. However, the modifications also caused a loss in drag coefficient. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-32747*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED WIND-TUNNEL INVESTIGATION OF TENSION-STRUCTURE PARAWINGS

Rodger L. Naeseth and Paul G. Fournier Washington, NASA, Jun. 1967 191 p refs

(NASA-TN-D-3940) CFSTI: $3.00 CSCL 01C

The static aerodynamic characteristics of all-flexible parawings, made of nonporous fabric and attached to a mounting bar by means of multiple suspension lines, were obtained. Planform variations included sweep angles of 40°, 45°, and 50°, different amounts and shapes of cuts which removed the apex of the wing, and variations in the shape of the flat-pattern leading edge. Also studied were the effects of adding stiffness to the keel by the use of flexible battens or by the use of a ram-inflated fabric tube on the keel. The basic wing configuration had 45° leading-edge sweep of the flat pattern and 1/8 keel length of the apex removed. Longitudinal- and lateral-control information and line-tension data were obtained on the basic wing for a very limited range of wing angles of attack. The maximum lift–drag ratio obtained for the basic all-flexible wing was about 2.4 and the maximum lift coefficient obtained was about 1.0. The longitudinal-stability characteristics indicated that the basic wing could be trimmed and had positive static stability over the angle-of-attack range from conditions of maximum lift–drag ratio up to stall. Only the stiffened-keel models showed substantially higher lift–drag ratios than the basic wing and these models provided maximum lift–drag ratios of approximately 3.2. Author

N67-32842# Planning Research Corp., Los Angeles, Calif.

ECONOMIC IMPLICATIONS OF A UNITED STATES SUPERSONIC TRANSPORT AIRCRAFT UPON AIRPORTS AND ENROUTE SUPPORT SERVICES. VOLUME III: ENROUTE SUPPORT SERVICES

Ronald E. Morris et al 31 Dec. 1966 156 p refs

(Contract FA-SS-66-15)

(PRC-R-890; Vol. III; AD-652307) CFSTI: HC $3.00/MF $0.65

This volume of the study to define the economic implications of a United States supersonic transport aircraft (SST) describes the major costs associated with necessary modifications to enroute support services. The degree of responsiveness of existing capabilities to the needs of the larger, faster, higher-flying aircraft which will join free world airfleets by 1975 is examined in relation to airways, navigation and communications, meteorology, and radiation. Proposed and evolutionary successor systems are identified. The nature and extent of improvements planned and the costs of their development, fabrication and installation are presented and discussed as related to the needs of the four advanced high-capacity aircraft types: stratched subsonics (DC-8-63), high-capacity subsonics (B-747), Concorde, United States SST. Author (TAB)

N67-32845*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FREE-STREAM INTERFERENCE EFFECTS ON EFFECTIVENESS OF CONTROL JETS NEAR THE WING TIP OF A VTOL AIRCRAFT MODEL

Kenneth P. Spreemann Washington, NASA, Aug. 1967 60 p refs

(NASA-TN-D-4084) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation in the transition speed range of the free-stream interference effects on control jets at the wing tip and at an inboard location of a model of a jet VTOL aircraft has been conducted in the 7- by 10-foot test section of 300-MPH 7- by 10-foot tunnel. The results showed that interference effects of the jets and free stream induced losses in the effective roll control; however, these losses were reduced as the jets were moved rearward and toward the wing tip. Sideslipping the wing forward or upstream gave negative (unfavorable) interference increments in rolling moment, whereas sideslipping the wing backward or downstream gave positive (favorable) increments. Aileron deflection had very little effect on the interference effects between the jets and free stream. Author

N67-33070*# National Aeronautics and Space Administration, Washington, D. C.

COMPILATION OF PAPERS SUMMARIZING SOME RECENT NASA RESEARCH ON MANNED MILITARY AIRCRAFT

Oct. 1960 177 p refs

(NASA-TM-X-420) CFSTI: HC $3.00/MF $0.65 CSCL 01C

(Declassified)

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N67-33071*# National Aeronautics and Space Administration, Washington, D. C.

COMPILATION OF PAPERS SUMMARIZING SOME RECENT NASA RESEARCH ON MANNED MILITARY AIRCRAFT. I. VTOL AIRCRAFT—STATE OF THE ART

Robert H. Kirby *In its* Compilation of Papers Summarizing Some Recent NASA Res. on Manned Military Aircraft Oct. 1960 p 1–12 (See N67-33070 19-02)

A summary is presented of the state-of-the-art in manned military VTOL aircraft, and an indication is made of the types which appear most promising. Applications where they are best suited are discussed, and an indication is made of what is needed in the way of additional research and development. It is concluded that the state-of-the-art in this field has advanced to the point where operationally useful machines of some VTOL types can be designed and built, and that efforts should be made to obtain operational machines to determine their capabilities under conditions of field operation. C.T.C.

N67-33072*# National Aeronautics and Space Administration, Washington, D. C.

II. AERODYNAMIC RESEARCH RELATIVE TO VARIABLE-SWEEP MULTIMISSION AIRCRAFT

Edward C. Polhamus and Alexander D. Hammond *In its* Compilation of Papers Summarizing Some Recent NASA Res. on Manned Military Aircraft Oct. 1960 p 13–38 (See N67-33070 19-02)

Some results of a research program to provide the aerodynamic information needed for the development of a variable-sweep multimission military aircraft are described. Research was directed toward the use of large sweep variations and the development of a method of controlling the longitudinal stability variation with sweep that would not require the fore and aft wing translation used in previous aircraft. Configurations were designed around two turbofan engines, and such areas as performance, effects of lift-curve slopes, longitudinal stability, and lateral stability and control were investigated. From actual calculations of performance estimates it appears that a variable sweep aircraft can provide for a great deal of versatility, and that one aircraft can perform several missions efficiently. C.T.C.

N67-33073*# National Aeronautics and Space Administration, Washington, D. C.

III. SUPERSONIC CRUISE AIRCRAFT

Donald D. Baals, Cornelius Driver, and Owan G. Morris *In its* Compilation of Papers Summarizing Some Recent NASA Res. on Manned Military Aircraft Oct. 1960 p 39–55 refs (See N67-33070 19-02)

A discussion is presented of the aerodynamic problems associated with large supersonic aircraft. The primary design factor of cruise efficiency is discussed in terms of the lift-drag ratio; and the geometric characteristics relative to the supersonic wave and friction drags, and the drag due to lift are considered in determining this efficiency. It is concluded that there has been a gradual improvement in supersonic cruise efficiency to a level approaching that of the best of the subsonic aircraft. The most obvious problems are in the off-design areas of landing, take-off, transonic acceleration, and subsonic hold. C.T.C.

N67-33075*# National Aeronautics and Space Administration, Washington, D. C.

V. THE X-15 FLIGHT RESEARCH PROGRAM IN RELATION TO THE DEVELOPMENT OF ADVANCED MILITARY AIRCRAFT

Jack Fischel *In its* Compilation of Papers Summarizing Some Recent NASA Res. on Manned Military Aircraft Oct. 1960 p 73–85 (See N67-33070 19-02)

A discussion is presented of the research objectives of the X-15 flight program, some of the flight aerodynamic characteristics currently being obtained, some of the development problems encountered, and the experience obtained with the advanced systems investigated. Flight studies performed up to Mach 3 are considered, and indicate that the aerodynamic force and heating data agree reasonably well with wind tunnel predicted data. Included are discussions of problems that were encountered in aerodynamics, structural dynamics, and systems operation. C.T.C.

N67-33076*# National Aeronautics and Space Administration, Washington, D. C.

VI. HYPERSONIC CRUISE VEHICLES

John M. Swihart and John R. Henry *In its* Compilation of Papers Summarizing Some Recent NASA Res. on Manned Military Aircraft Oct. 1960 p 87–105 (See N67-33070 19-02)

A brief summary is presented of the state-of-the-art in aerodynamics, aerodynamic heating, and propulsion relative to hypersonic vehicles, and an indication is made of the performance possibilities of such aircraft based on this state-of-the-art. The discussion is confined to cruising vehicles which are boosted to cruise speed and altitude, and for this purpose a Mach number of 6 was chosen as the design point. This is considered to be about the limiting Mach number for the use of hydrocarbon fuel and is also considered to be a logical starting point for the use of liquid hydrogen fuel. It is concluded that the state-of-the-art is such that lift-drag ratios of sufficient magnitude to give satisfactory range can be obtained. The thermodynamics of the propulsion units yield values of propulsive efficiency which, when coupled with the aerodynamic efficiency, indicate desirable range–payload possibilities. The aerodynamic heating is low enough to allow construction of such a vehicle with the present capability of the aviation industry. C.T.C.

N67-33078*# National Aeronautics and Space Administration, Washington, D. C.

VIII. NOISE CONSIDERATIONS FOR FUTURE MANNED AIRCRAFT

Harvey H. Hubbard and Domenic J. Maglieri *In its* Compilation of Papers Summarizing Some Recent NASA Res. on Manned Military Aircraft Oct. 1960 p 129–141 refs (See N67-33070 19-02)

Some of the principal noise problems anticipated for propeller and jet powered V/STOL aircraft, large high altitude supersonic cruise aircraft, and special mission aircraft capable of supersonic flight at low altitudes are discussed. The main noise sources are noted to be the power plants, the boundary layer, and the shock waves. Engine noise problems will be of major concern in commercial type of operations with V/STOL and with the supersonic transport, particularly during the landing operation. Boundary layer noise is of importance for aircraft such as the supersonic transport and any special mission aircraft that fly at high dynamic pressures. Special provision will have to be made in the design of the supersonic transport to allow it to operate at sufficient altitudes so as to minimize sonic boom disturbances. C.T.C.

N67-33079*# National Aeronautics and Space Administration, Washington, D. C.

IX. SIMULATION REQUIREMENTS FOR THE DEVELOPMENT OF ADVANCED MANNED MILITARY AIRCRAFT

Euclid C. Holleman and Milvin Sadoff (NASA, Ames Res. Center) *In its* Compilation of Papers Summarizing Some Recent NASA Res. on Manned Military Aircraft Oct. 1960 p 143–159 refs (See N67-33070 19-02)

A review is presented of some of the more recent simulator results, with emphasis on aircraft design problem areas. Some of the simulator requirements for V/STOL and low altitude aircraft are also presented. Areas requiring additional effort are discussed, and the piloted flight simulator associated with the X-15 research aircraft program is briefly described. It is concluded that the fixed-base simulator with adequate presentation and controls is satisfactory for the investigation of a wide range of aircraft problems; however, there are areas where realism can be enhanced by suitable motion and visual environment stimuli. It is noted that caution should be taken to avoid unnecessary complexity and costs which would actually retard the development of the aircraft. C.T.C.

N67-33082 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugfuehrung.
CALCULATION METHOD FOR THE DETERMINATION OF THE DYNAMIC BEHAVIOR OF AN AIRCRAFT WITH VARIOUS CONTROLLERS [RECHENVERFAHREN ZUR ERMITTLUNG DES DYNAMISCHEN VERHALTENS EINES FLUGZEUGES MIT VERSCHIEDENEN REGLERAUFSCHALTUNGEN]
G. Schaenzer Mar. 1967 75 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-27)

A computer program allowing the investigations in the dynamic performance is discussed. The results are given in the form of the natural modes of the automatically controlled aircraft (closed loop poles). The characteristic vectors are represented in polygons of time vectors. The closed loop pole configuration is shown by the root loci for varied controller settings. Author

N67-33219# Planning Research Corp., Los Angeles, Calif.
ECONOMIC IMPLICATIONS OF A UNITED STATES SUPERSONIC TRANSPORT AIRCRAFT UPON AIRPORTS AND ENROUTE SUPPORT SERVICES. VOLUME II: AIRPORTS AND TERMINALS
Ronald E. Morris, John B. Burcham, Jr., George W. S. Johnson, Kelly J. Black, Richard C. Hannon et al 31 Dec. 1967 129 p refs
(Contract FA-SS-66-15)
(PRC-R-890, Vol. II; AD-652306) CFSTI: HC $3.00/MF $0.65

The economic impact of advanced high-capacity airliners upon the ground-environment-airports and terminals is examined in this volume. The modifications required to achieve compatibility with each of the four airliners: stretched subsonic (DC-8-63), high-capacity subsonic (B-747), Concorde, United States SST which will enter commercial service up to 1975 are defined for selected airports, and the costs of the aircraft-sponsored improvements are estimated. Author (TAB)

N67-33248# David Taylor Model Basin, Washington, D. C.
SOME DESIGN PRINCIPLES OF GROUND EFFECT MACHINES. SECTION F: CUSHION CONTRIBUTIONS TO STABILITY
Harvey R. Chaplin and Allen G. Ford Feb. 1967 40 p
(DTMB-2121F; DTMB-AERO-1100F; AD-653859) CFSTI: HC $3.00/MF $0.65

A review is undertaken of some of the more important elementary relationships which determine the influence of the air cushion on the pitch, heave, and roll stability of ground effect machines. The analyses presented yield only rough approximations of the quantities needed for design. Further, the analyses are restricted to cases of vehicles which are not in contact with the surfaces over which they travel, whereas the influences of surface contact are of primary importance in most practical problems. Author (TAB)

N67-33254*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OVER MOVING GROUND PLANE OF A TRANSPORT AIRPLANE MODEL USING BLOWING OVER FLAPS FOR BOUNDARY-LAYER CONTROL
Raymond D. Vogler Washington, NASA, Aug. 1967 86 p refs
(NASA-TN-D-4083) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation at low speeds over a still and a moving ground plane was made to determine the effects of ground proximity on the longitudinal aerodynamic characteristics of a model of a transport airplane. The four-engine model was equipped for blowing over the flaps for boundary-layer control. Compressed air was used to furnish flap blowing as well as to furnish the thrust for the two inboard engines. The model was investigated in and out of ground effect through an angle-of-attack range, a flap blowing momentum range, and a thrust range. Results show that flap blowing substantially increases (100 percent at $\alpha=0°$) the lift coefficient through the angle-of-attack range in or out of ground effect. The presence of the ground reduces the lift and drag coefficients and reduces the down load on the tail; thereby, more negative tail incidence is required for trim. The lift reduction increases with increase in flap blowing and height reduction to a maximum of about 20 percent of the out-of-ground-effect lift. The still and the moving ground planes show negligible difference in effect on model forces and moments except for the model very close to the ground and with a large amount of blowing momentum where the more realistic moving ground plane shows small increments of increased lift, decreased drag, and positive pitch when compared with the still ground plane. Author

N67-33454*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC CHARACTERISTICS OF A LARGE-SCALE V/STOL TRANSPORT MODEL WITH LIFT AND LIFT-CRUISE FANS
Leo P. Hall, David H. Hickey, and Jerry V. Kirk Washington, NASA, Aug. 1967 88 p refs
(NASA-TN-D-4092) CFSTI: HC $3.00/MF $0.65 CSCL 01C

A wind-tunnel investigation was conducted to determine the aerodynamic characteristics of two configurations of a V/STOL transport model powered by tip-turbine-driven fans. The VTOL propulsion system for the first configuration was a combination of lift fans and rotating cruise fans, and for the second configuration was tandem mounted lift fans. Both configurations used a high mounted wing with an aspect ratio of 5.8, swept back 35° at the quarter chord line, and a taper ratio of 0.3. The results showed a large increase in lift with forward speed for both configurations in spite of the unloading of the wing induced by front fan operation. Longitudinal characteristics for both configurations with the fans operating appear to be similar to the characteristics of conventional aircraft; however, both configurations suffer directional instability over at least part of the speed range. Author

N67-33457*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RELATIONSHIP BETWEEN MAGNITUDE OF APPLIED SPIN RECOVERY MOMENT AND ENSUING NUMBER OF RECOVERY TURNS
Ernie L. Anglin Washington, NASA, Aug. 1967 36 p refs
(NASA-TN-D-4077) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An analytic study has been made to investigate the relationship between the magnitude of the applied spin recovery moment and the ensuing number of turns made during recovery from a developed spin with a view toward determining how to interpolate or extrapolate spin recovery results with regard to determining the amount of control required for a satisfactory recovery. Five configurations were used which are considered to be representative of modern airplanes: a delta-wing fighter, a stub-wing research vehicle, a boostglide configuration, a supersonic trainer, and a sweptback-wing fighter. The results obtained indicate that there is a direct relationship between the magnitude of the applied spin recovery moments and the ensuing number of recovery turns made and that this relationship can be expressed in either simple multiplicative or exponential form. Either type of relationship was adequate for interpolating or extrapolating to predict turns required for recovery with satisfactory accuracy for configurations having relatively steady recovery motions. Any two recoveries from the same developed spin condition can be used as a basis for the predicted results provided these recoveries are obtained with the same ratio of recovery control deflections. No such predictive method can be expected to give satisfactory results for oscillatory recoveries. Author

N67-33679* Northrop Corp., Hawthorne, Calif. Norair Div.
AIRCRAFT PRELIMINARY DESIGN REPORT V/STOL JET OPERATIONS RESEARCH AIRPLANE DESIGN STUDY. VOLUME III—SUBSTANTIATING TECHNICAL DATA
1967 506 p refs
(Contract NAS1-6777)
(NASA-CR-66719) CSCL 01C

Substantiating technical data for the Northrop modified T-38A NASA V/STOL jet operations research aircraft are presented. Details are given of configurations, aerodynamics, propulsion, the reaction control system, structures, subsystems, flight controls, SAS and VAS systems, and reliability requirements. N.A.S.

N67-33825* Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
PART I—AIRCRAFT PRELIMINARY DESIGN REPORT V/STOL JET OPERATIONS RESEARCH AIRPLANE DESIGN STUDY—SECTIONS I TO V
G. Rosenthal, J. Chung, E. Schiller, J. Wright, and E. Vogel [1967] 345 p refs
(Contract NAS1-6778)
(NASA-CR-66421) CFSTI: HC $3.00/MF $0.65 CSCL 01C

A basic description and the dimensional data are presented for the new conceptual aircraft which contains two lift-cruise and six lift turbojet engines. The modified existing aircraft, Concept J, has two lift-cruise and eight lift engines of the same type. Conventional and subaerodynamic performances of both aircraft are estimated, and geometry and basic aerodynamic characteristics are presented. Summaries are given of propulsion, thermodynamic analytical design data, and system design data. The design data include performance of the reaction control system and the environmental control system. Final weight and balance estimates are also presented. K.W.

N67-33826*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
PART II—AIRCRAFT PRELIMINARY DESIGN REPORT V/STOL JET OPERATIONS RESEARCH AIRPLANE DESIGN STUDY—SECTIONS VI TO XI
G. Rosenthal, J. Chung, E. Schiller, J. Wright, and E. Vogel [1967] 315 p refs
(Contract NAS1-6778)
(NASA-CR-66422) CSCL 01C

Stability and control summaries are presented for hovering and for vertical, transitional, and conventional flight modes. Flight dynamics analyses were performed for the stability augmentation system, the variable stability system, and the model of an operational V/STOL aircraft. Included are the time histories of normal and emergency subaerodynamic flight maneuvers. Results are presented for structural, acoustical, and flutter criteria investigations, and the corresponding material lists, structural and component diagrams, and detailed structural analyses are included. Avionics equipment, antennas, and electrical power distribution, and load profiles were studied. The flight controls system and the hydraulic system are described. Summaries are given which cover cockpit arrangement, instrumentation, crew subsystems, crew station recommendations, escape system layouts, and visibility studies. Briefly discussed are also systems availability during a proposed research program, quality assurance, and reliability calculations for the new aircraft concept. K.W.

N67-33875*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC STABILITY CHARACTERISTICS AT MACH NUMBERS FROM 1.90 TO 4.63 OF A 76° SWEPT ARROW WING MODEL WITH VARIATIONS IN HORIZONTAL-TAIL HEIGHT, WING HEIGHT, AND DIHEDRAL
Dennis E. Fuller Washington, NASA, Aug. 1967 117 p refs
(NASA-TN-D-4076) CFSTI: $3.00 CSCL 01D

An investigation has been made to determine the effects of horizontal-tail height, wing height, and dihedral on the longitudinal and lateral stability characteristics of a 76° swept arrow wing aircraft model. The horizontal-tail height was varied from a position below the fuselage to a position near the top of the vertical tail, in combination with a high wing having 5°, 0°, and −5° dihedral, and with a low wing having 5° and 0° dihedral. Tests were performed at Mach numbers from 1.90 to 4.63, and angles of attack from about −4° to 20°, and at angles of sideslip from about −4° to 8°. Results of the investigation indicate that generally, for the angle-of-attack and Mach number range presented herein, the horizontal tail mounted above the fuselage passes through an adverse flow region and results in pitching-moment nonlinearities. The horizontal tail mounted below the fuselage resulted in noticeably higher directional stability in the low angle-of-attack range than did the horizontal tail in the other locations. However, the decrease in directional stability with increasing angle of attack generally was least with the high tail. The low-wing configurations provided higher directional stability than did the high-wing configuration at all test Mach numbers and angles of attack. Positive increments in effective dihedral were produced by the high wing and by positive geometric dihedral, the opposite effect being produced by the low wing or by negative geometric dihedral. A positive increment in effective dihedral was also produced by the high horizontal tail at the low Mach numbers. Author

N67-33914# Federal Aviation Agency, Washington, D. C.
UNITED STATES SUPERSONIC TRANSPORT ECONOMIC FEASIBILITY REPORT
Apr. 1967 228 p
(AD-652313) CFSTI: HC $3.00/MF $0.65

During the next two or three decades when the SST will be flown by the Free Worlds airlines, effective competition can be expected from improved subsonic airplanes as well as from the French/British Concorde. Even so, the study concludes that the market for the SST should be at least 500 airplanes; it should earn for the airlines and manufacturers a profit consistent with their risks; and the Government should recover its investment plus interest. TAB

N67-33924 National Aeronautical Establishment, Ottawa (Ontario).
SOME PROBLEMS IN CONTROL ARISING FROM OPERATIONAL EXPERIENCES WITH JET TRANSPORTS
B. Caiger [1967] 18 p refs

Turbulence upsets and accidents involving large jet transports have indicated problems in control under unusual flight conditions, including (1) the effect of turbulence-induced fuselage vibration on ability of pilot to read flight instruments, (2) adverse pilot inputs due to difficulty in interpreting flight instrument data and pilot disorientation effects from turbulence, and (3) pitch control deficiencies and high speed dives. Vibration levels at the flight deck during severe turbulence encounters are considered to need further study, as are potential benefits of head-up displays in enabling the pilot to acquire flight instrument information during vibration and flight measurements of pilot control inputs in severe turbulence and contributions of any related disorientation effects. It is recommended that design dive speed requirements for jet transports be made more severe, and that adequate primary pitch control should be available without reliance on trim devices. M.W.R.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-32967# Eagle-Picher Co., Joplin, Mo. Couples Dept.
ADVANCED DEVELOPMENT MODELS OF VENTED NICKEL–CADMIUM BATTERIES
H. H. Lafollette and E. S. Carr Feb. 1967 57 p
(Contract DA-28-043-AMC-00065(E))
(NA-121; ECOM-00065-T; AD-651961) CFSTI: HC $3.00/MF $0.65

Sixteen batteries each of BB-435()/U, BB-437()/U, BB-438()/U and BB-439()/U were subjected to the Acceptance Tests of Paragraph 4.3.1 of Specification SCL-6867B dated September 18, 1963. The lot for each battery type was deemed acceptable based on performance during these tests. Batteries of each type were subjected to cycling tests of Paragraph 4.3.2 with the objective of meeting 1008 cycles. The average number of cycles completed was as follows: BB-435()/U, 1008 cycles; BB-437()/U, 859 cycles; BB-438()/U, 617 cycles and BB-439()/U, 283 cycles. Author (TAB)

N67-33012*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRESENT STATUS OF LITHIUM DIFFUSED SILICON SOLAR CELLS
P. H. Fang Mar. 1967 65 p refs
(NASA-TM-X-55860; X-713-67-138) CFSTI: HC $3.00/MF $0.65
CSCL 10A

A brief history of work on lithium-diffused semiconducting silicon is given, and a few experimental results on the radiation effects and the aftereffects are discussed. The radiation damage and recovery of lithium-diffused solar cells is analyzed from the physical point of view. Experimental results of the initial efficiency, and the subsequent radiation damage recovery are also discussed. Author

N67-33021* American Cyanamid Co., Stamford, Conn. Stamford Research Labs.
DEVELOPMENT OF HIGH-PERFORMANCE LIGHT-WEIGHT ELECTRODES FOR HYDROGEN–OXYGEN FUEL CELLS Semiannual Report, 1 Jul. 1966–31 Dec. 1966
W. P. Colman, K. E. Olson, and E. W. Schmitz 15 Jul. 1967 103 p refs
(Contract NAS3-8524)
(NASA-CR-72268) CSCL 10A

The overall objective is to determine and recommend preferred matrix materials and operating conditions under which American Cyanamid AB-40 electrodes would be capable of 2000-hour performance, in a total module having a weight-to-power ratio substantially lower than those presently available for space environment. Several new matrix materials were evaluated and included in a life testing program. The electrodes and matrices were life-tested in small cells at current densities up to 600 ma/cm^2, and factors contributing to performance stability investigated. A new, five-station, facility for life testing in battery-size single cells was designed, constructed and checked out. Cell assembly problems were studied. Author

N67-33285# Ball Bros. Research Corp., Boulder, Colo.
A CONTROL SYSTEM FOR DESPUN PAYLOAD ORIENTATION
G. R. Strevey 27 Jun. 1967 13 p
(TN67-40)

A despin control system used to orient devices to the earth from a spin stabilized spacecraft is described. The control system, designed for single axis control about nadir, uses an Orbiting Solar Observatory despin drive. The control concept described involves centering a reference pulse and indicating the nadir position relative to earth limb pulses generated by horizon sensors. Included is a block diagram, a cutaway drawing, and a photograph of a breadboard demonstration model of the controller. The final section explains how this particular development fits into the general category of spacecraft despin control. Author

N67-33293# Harry Diamond Labs., Washington, D. C.
FLUERIC DIVERTER VALVE
Allen B. Holmes and Carl J. Campagnuolo Apr. 1967 33 p refs
(HDL-TR-1348; AD-653617) CFSTI: HC $3.00/MF $0.65

The experimental work leading to the development of a flueric diverter valve (FDV) is described. The work has shown that a gas flow can be controlled in a three-dimensional aerodynamic valve that has no moving internal parts. In the Phase I effort, flow tests of various power nozzle configurations were completed, and a subscale model of the FDV was evaluated under simulated V/STOL operating conditions. A major objective is design of a unit of practicable size that will operate at subsonic and supersonic pressure ratios. In flow tests using cold gas at 0 to 45 psig, a subscale model of the FDV diverted 100 percent of the flow with the control orifice vented to atmosphere. The overall valving efficiency defined in terms of a thrust recovery factor for various nozzles (not optimized) typically measured 0.83. Author (TAB)

N67-33332# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
GERMANIUM SOLAR CELLS [PHOTOPILES SOLAIRES AU GERMANIUM]
Jean Tavernier (Paris Univ.), Paul Sebillot, and Emile Le Grives 1967 48 p refs In FRENCH; ENGLISH summary Presented at the AGARD Meeting on Prediction of Performances of Some Static Energy Conversion Devices, Liege, 12–16 Jun. 1967
(ONERA-TP-478(1967)) CFSTI: HC $3.00/MF $0.65

Germanium solar cells are shown to be well suited for high intensity solar conversion devices. Preliminary experiments have been worked up to 20 W cm^{-2} power density, and a conversion efficiency more than twice that of silicon cells was obtained. Author (ESRO)

N67-33377*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SPHERICAL FOCUSED BLAST DEVICE
R. L. McCally *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

A 2-inch-dia sphere of a Composition C-4 was built and fired to determine feasibility of the focused blast concept for antiaircraft missile warheads. The sphere was initiated at 12 points to produce proper delays, and several tests were performed to develop an initiation system that could produce the desired delays at all the points with an accuracy greater than 0.10 μsec. The four points in the equatorial plane were initiated at $t = 0$ μsec. Lengths of 0.190-inch-dia Detacord were found to produce the required delays with the required accuracy; and framing photographs indicated that focusing was achieved. M.W.R.

N67-33421* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPTIMAL CONTROL APPLICATIONS FOR ELECTROTHERMAL MULTIJET SYSTEMS ON SYNCHRONOUS EARTH SPACECRAFT
William C. Isley Aug. 1967 12 p refs To be presented at the AIAA Electric Propulsion and Plasmadyn. Conf. Colorado Springs, 11–13 Sep. 1967
(NASA-TM-X-55869; X-734-67-368) CSCL 22B

The application of multijet electrothermal systems for three-axis attitude control and station keeping of 24 hour synchronous communication-satellites is studied in a versatile system simulation that uses operational propulsion system hardware in closed loop tests. Mission parameters require precise slewing capability to meet antenna fine pointing to ±0.1° in limit cycle mode over the full earth disc. Using coupled three-degree-of-freedom attitude equations and disturbance torques, an optimal control policy is synthesized for the slewing maneuver having a performance index based upon time optimal, propellant/power optimal, and weighting of attitude rates. For constant mass flow propellant feed systems, thrust level degradation was shown to drastically influence both maneuvering time and propellant consumption. A typical case involved a nominal 3 minute slewing time for a pointing vector excursion of 6 degrees. Control stability was demonstrated for thrust degradation in excess of 75% of nominal values. Author

N67-33491 Library of Congress, Washington, D. C. Aerospace Technology Div.
DIRECT ENERGY CONVERSION IN THE USSR. SOVIET SOLAR CONCENTRATORS Surveys of Foreign Scientific and Technical Literature
Z. Litynski 30 Nov. 1966 142 p refs
(ATD-66-138; Rept.-4)

Theoretical aspects, concentrator design, direct energy conversion applications, and materials and manufacturing processes are considered in a review of Soviet development of solar energy conversion systems. Basic calculations are made for an ideal system and for a real solar concentrator, and attainable temperature, precision index, and cavity calculations are included. Paraboloids, parabolic-cylindrical concentrators, and other geometries are considered, along with multimirror systems. Photovoltaic and thermoelectric systems for applications in space are discussed in detail. Glass, aluminum, asbestos-cements, resins, and foam materials are mentioned; and reinforced concrete shells and elastic membranes are discussed. M.W.R.

N67-33530# Globe-Union, Inc., Milwaukee, Wis. Applied Research Labs.
LITHIUM-MOIST AIR BATTERY
Jorge E. A. Toni, R. L. Zwaagstra, and William E. Elliott Mar. 1967 41 p refs
(Contract DA-44-009-AMC-1552(T))
(SAR-2; AD-653774) CFSTI: HC $3.00/MF $0.65

Work was directed toward the understanding of the mechanism of the oxygen reduction (air electrode) in nonaqueous media. The smooth platinum/O2 saturated phenyltrimethyl ammonium hexafluorophosphate-nitrosodimethylamine system was studied extensively. The effect of water on the kinetics was also included. The overall process of oxygen reduction is a complex mechanism which includes two main reduction steps. The first reduction step includes an ECE mechanism with disproportionation as a side complication. The ECE mechanism consists of the reduction of oxygen to peroxide with superoxide as an intermediate. The second step is very irreversible and possibly is the reduction of peroxide to hydroxide which can only occur when protons are available. Water (protons) plays an important role in all of the mechanism. Accumulation of oxygen on the electrode and interaction between O2 and Pt was also studied. Author (TAB)

N67-33541# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELEMENTS AND DRIVES OF POWER FOLLOW-UP SYSTEMS Collection of Articles
13 Jan. 1967 230 p refs Transl. into ENGLISH of the book "Elementy i Privody Silovykh Sledyashchikh Sistem" Moscow, Oborongiz., 1961 p 1–203
(FTD-MT-64-92; TT-67-60933; AD-646932) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. FUNDAMENTALS OF THE THEORY OF THE CALCULATION OF COMBINED CONTROL SYSTEMS V. G. Terskov p 3–46 refs (See N67-33542 19-10)

2. QUESTIONS IN THE CALCULATION AND DESIGNING OF COMBINED CONTROL SYSTEMS V. G. Terskov p 47–80 refs (See N67-33543 19-10)

3. STATIC AND DYNAMIC CHARACTERISTICS OF THE HYDRAULIC DRIVE "NOZZLE-GATE-HYDRAULIC CYLINDER" N. A. Borisova p 81–91 ref (See N67-33544 19-03)

4. THE HYDRAULIC AMPLIFIER OF THE TYPE "NOZZLE-GATE" N. S. Gamynin p 93–102 refs (See N67-33545 19-03)

5. CHARACTERISTIC OF THE PUMPS AND VALVES, HYDRAULIC MOTORS USED IN FOLLOW-UP SYSTEMS N. S. Gamynin p 103–109 refs (See N67-33546 19-03)

6. CHARACTERISTIC OF ELECTROMECHANICAL CONVERTERS WITH A MAGNETIC SPRING V. I. Gusakov p 111–125 refs (See N67-33547 19-03)

7. SELECTING THE RATIO OF THE POWER REDUCTORS FOR FOLLOW-UP DRIVES B. I. Petrov p 127–147 refs (See N67-33548 19-03)

8. CONTROL CHARACTERISTICS OF THE REVERSIBLE MAGNETIC AMPLIFIER, WORKING ON A COMPLEX LOAD V. V. Kryuchkov p 149–173 refs (See N67-33549 19-03)

9. PARALLEL AND IN SERIES CONNECTION OF TWO ELECTRONIC TUBES TO ONE LOAD WITH VARIABLE ANODE FEED E. M. Reshetnikov p 175–189 refs (See N67-33550 19-09)

10. THE CALCULATION OF THE STRENGTH OF SINGLE-LAYER BELLOWS, USED IN CERTAIN PNEUMATIC DEVICES WITH LARGE PRESSURE DROPS V. V. Kuchinskiy p 191–205 refs (See N67-33551 19-03)

N67-33544# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATIC AND DYNAMIC CHARACTERISTICS OF THE HYDRAULIC DRIVE "NOZZLE-GATE-HYDRAULIC CYLINDER"
N. A. Borisova *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 81–91 ref (See N67-33541 19-03)

The performance of a nozzle-gate-hydraulic cylinder" drive for an aircraft control system is calculated, and the discharge characteristics of the nozzle gate are derived. Author

N67-33545# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE HYDRAULIC AMPLIFIER OF THE TYPE "NOZZLE-GATE"
N. S. Gamynin *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 93–102 refs (See N67-33541 19-03)

The nozzle-gate hydraulic amplifier is used in electrohydraulic control-surface actuators as an additional amplifier stage between a sensitive low-capacity polarized relay and a valve mechanism. Author

N67-33546# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CHARACTERISTIC OF THE PUMPS AND VALVES, HYDRAULIC MOTORS USED IN FOLLOW-UP SYSTEMS

N. S. Gamynin *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 103–109 refs (See N67-33541 19-03)

The characteristics of slave hydromotors, regulated hydraulic pumps, and valve mechanisms are considered. The geometric, speed, and power indices of hydromotors are determined by the coefficients of specific delivery, and formulas for these parameters are given. L.S.

N67-33547# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CHARACTERISTIC OF ELECTROMECHANICAL CONVERTERS WITH A MAGNETIC SPRING

V. I. Gusakov *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 111–125 refs (See N67-33451 19-03)

Permeance, differential equations of motion, and static and frequency characteristics of electromechanical torque motor converters, are presented from a theoretical basis. The type of electromechanical converters (with magnetic springs) discussed are being widely employed in follow-up systems. L.S.

N67-33548# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SELECTING THE RATIO OF THE POWER REDUCTORS FOR FOLLOW-UP DRIVES

B. I. Petrov *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 127–147 refs (See N67-33541 19-03)

A method is given for selecting transmission ratios of follow-up drive reduction gears based on the dynamic accuracy of the follow-up drive. Author

N67-33549# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONTROL CHARACTERISTICS OF THE REVERSIBLE MAGNETIC AMPLIFIER, WORKING ON A COMPLEX LOAD

V. V. Kryuchkov *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 19-173 refs (See N67-33541 19-03)

The amplitude and phase responses of load current and voltage of an ac push-pull magnetic amplifier are calculated and a differential magnetic amplifier is examined. Author

N67-33551# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE CALCULATION OF THE STRENGTH OF SINGLE-LAYER BELLOWS, USED IN CERTAIN PNEUMATIC DEVICES WITH LARGE PRESSURE DROPS

V. V. Kuchinskiy *In its* Elem. and Drives of Power Follow-up Systems 13 Jan. 1967 p 191–205 refs (See N67-33541 19-03)

Hypotheses, mathematical relationships, and concepts concerning applications of bellows devices in consolidators and sensors in air reductors, electropneumatic valves, and other special purpose pneumatic units, are presented. Calculations for the work conditions needed for construction of the bellows required, are given. These include conditions of stability for equilibrium positions of the loaded bellows. The possibility of constructing tables to facilitate the calculation of bellows, is also discussed. L.S.

N67-33711# Sonotone Corp., Elmsford, N. Y.

STANDARD LINE-BATTERY ASSEMBLY BB-610 (U) NICKEL CADMIUM VENTED Final Report, 29 Apr. 1966–17 Jan. 1967

Raymond Nathe and John Herrmann Jun. 1967 151 p (Contract DA-28-043-AMC-01508(E))

(ECOM-01580-F; AD-654130) CFSTI: HC $3.00/MF $0.65

The report covers the concluding research and development activities which have been directed toward the design of a 12-volt, 14 A.H., Nickel-Cadmium, vented battery housed in a fiberglas case. This report attests that the contracted battery has met all the requirements of the applicable specifications. For the results of certain environmental tests, Sonotone has supplied their certified test data sheets. For the results of acceleration, bounce, and vibration, United Aerotest Inc. has supplied their own test data. Included in the report are the batterys official parts list, listed in order of parts breakdown, and accompanied by page-size assembly drawings of all battery parts. Overall conclusions and recommendations are given concerning the program and ideas are submitted for consideration on any similar future programs. Author (TAB)

N67-33848 Naval Ammunition Dept. Crane Ind. Quality Evaluation Dept.

EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS ACCEPTANCE TEST OF GULTON INDUSTRIES, INC. 4.0 AMPERE–HOUR FLOODED, SEALED NICKEL-CADMIUM SECONDARY SPACECRAFT CELLS WITH COULMETER CHARGE CONTROL

26 May 1967 20 p refs

(NASA Order W-11252B)

(NASA-CR-87175; QE/C-67-307) CSCL 10A

Capacity, call short, and overcharge tests were performed on the nickel–cadmium cells at an ambient temperature between 23° and 27°C at existing relative humidity and atmospheric pressure. Test results are tabulated and characteristic overcharge curves are shown. R.N.A.

N67-33947# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

ELECTRONIC EQUIPMENT USED FOR I.R. RADIATION MEASUREMENT DURING A SPACE EXPERIMENT [CHAINES ELECTRIQUES UTILISEES AU COURS D'UNE EXPERIENCE SPATIALE POUR LA MESURE DE RAYONNEMENTS INFRAROUGE]

Michel Gay 1967 10 p In FRENCH Presented at the Intern. Colloq. on Electron. and Space, Paris, 10–15 Apr. 1967

(ONERA-TP-465(1967)) CFSTI: HC $3.00/MF $0.65

The experiment TACITE carried out by the C.N.E.S. (Centre National d'Etudes Spatiales) took place successfully June 15th, 1965. It was possible to investigate the I.R. contrast between earth and space on wavelengths between 4 and 35μ by means of thermal effect detectors. The electronic problems corresponding to using this type of detectors are described. The success of this attempt opened the way to new scientific experiments in space. The technological advances made since the first experiment enable the author to design an electronic equipment whose sensitivity threshold reaches the ultimate limits given by the noise of the receiver. Such equipment, already in use in the laboratory, will be mounted on an experimental missile in the next flight-tests. Author (ESRO)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-32729# Yale Univ., New Haven, Conn.

PROLONGED STRESS IN SEALAB II: A FIELD STUDY OF INDIVIDUAL AND GROUP REACTIONS

Robert L. Helmreich (Ph.D. Thesis) [1967] 96 p refs
(Grants Nonr(G)-00012-66; Nonr(G)-00030-66)
(TR-1; AD-651974) CFSTI: HC $3.00/MF $0.65

An investigation was made of individual and group reactions to extreme, prolonged stress in a field situation conducted as part of Project SEALAB II. The 28 divers completed personality and demographic questionnaires prior to submersion. While underwater, they filled out checklists and were continuously monitored by closed-circuit audio and television. Divers underwater were significantly more fearful and aroused than on the surface prior to submersion. The three 10 men teams which lived together underwater became significantly more cohesive after submersion. Evaluation of sociometric choices of leaders indicated that age and maturity were the only characteristics associated with being chosen as a leader. Performance, fear, arousal, gregariousness and choice as a peer were not related to leader choice. Self-reported fear and arousal were significantly correlated with performance criteria. The more frightened and aroused divers demonstrated inferior performance. First-born and only children were significantly more frightened and showed significantly poorer performance than later-borns. Failure of an individual to share in group activities and social behavior was associated with higher levels of reported stress and inferior performance. Using six predictors in a multiple regression, it was possible to account for 50% of the variance of each of three objective performance criteria. Author (TAB)

N67-32771# Naval Medical Research Inst., Bethesda, Md.
THE NMRI DEEP ISOLATION LABORATORY Research Report
Seward Smith, Thomas I. Myers, and Peter M. Edmondo May 1967 25 p refs
(Rept.-27; AD-653074) CFSTI: HC $3.00/MF $0.65

The Naval Medical Research Institute deep-isolation laboratory is described and various aspects of its instrumentation are detailed. The lab consists of six highly-sound-reduced rooms and an adjacent control room. The rooms contain full life-support facilities for carrying out multiple-day studies of isolated confinement. Safety monitoring and psychological testing are conducted from the control room with no required physical contacts with test subjects. Automated testing and data recording are carried out, in some cases 24 hours a day, utilizing a versatile audio system and extensive programming and data recording equipment. This description emphasizes the furnishings and instrumentation installed for Project COMONOT, a study of 7-day isolation of individuals under different conditions of monotony and social contact. Author (TAB)

N67-32799# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSIOLOGICAL BASES FOR INCREASED ENDURANCE OF PEOPLE UNDER INTENSE THERMAL CONDITIONS
S. A. Iosel'son 20 Mar. 1967 117 p refs Transl. into ENGLISH of the book "Fiziologicheskiye Osnovy Povysheniya Vynoslivosti Lyudey k Intensivnym Teplovym Vozdeystviyam", Leningrad, Mediz., 1963 p 1–88
(FTD-MT-65-493; TT-67-62019; AD-652475) CFSTI: HC $3.00/MF $0.65

The report considers questions of man's endurance under intense thermal conditions. Data are introduced concerning the physiological mechanisms of adaptation of the organism to high temperatures and to increased atmospheric humidity. Methods of increasing tolerance of the organism to thermal influences are investigated and certain peculiarities of hygiene and labor physiology of mine-rescue workers are discussed. Author (TAB)

N67-32854# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
THE SCOPE OF BLAST AND SHOCK BIOLOGY AND PROBLEM AREAS IN RELATING PHYSICAL AND BIOLOGICAL PARAMETERS Technical Progress Report
Clayton S. White Nov. 1966 32 p refs
(Contract DA-49-146-XZ-372)
(DASA-1856; AD-653024) CFSTI: HC $3.00/MF $0.65

A few introductory remarks are followed by a brief discussion of the nature of hazards from air blast noting those due (a) directly to variations in pressure and (b) indirectly to the impact of penetrating and nonpenetrating, blast-energized missiles and the consequences of whole body displacement due to blast-induced winds or ground shock. The need for developing biomedical criteria based upon critical and measurable biological responses following exposure to significant and monitorable physical parameters is discussed in relation to hazards assessment. Also the multifaceted problem of tying up such information with blast-induced variations in the environment that occur free-field and under various conditions of exposure is noted and emphasized. Author (TAB)

N67-32871# Navy Electronics Lab., San Diego, Calif.
DIVERS' BODY HEAT LOSS: DESCRIBES A STUDY OF THE ENDURANCE OF UNDERWATER SWIMMERS WEARING A VARIETY OF FOAM NEOPRENE WET SUITS AND IMMERSED AT 30–32° F IN THE NEL ARCTIC POOL
J. A. Beagles and E. F. Coil 10 Oct. 1966 39 p refs
(NEL-1408; AD-652405) CFSTI: HC $3.00/MF $0.65

A study was made primarily to obtain data applicable to the design of an optimum protective suit for divers in arctic environments. The experimental method employed swimmers who performed shallow dives in the NEL Arctic Pool at 30-32F. Skin temperature was recorded by the use of suitably located thermistors, and other data were obtained from blood samples drawn immediately before and after each dive. Results suggest that a four-piece foam neoprene wet suit consisting of a 1/8-inch tight-fitting inner suit and a 1/4-inch snug-fitting outer suit along with two pairs of neoprene socks and mittens would provide the optimum combination of protection and mobility for divers in arctic waters. Author (TAB)

N67-32875# Kobe Univ. (Japan). School of Medicine
STUDIES OF THE MAMMALIAN BRAIN FUNCTION IN VITRO
Isamu Suda Apr. 1967 6 p
(Grant DA-CRD-AG-S92-544-67-G52)
(J-293-1; AD-651979) CFSTI: HC $3.00/MF $0.65

Summaries are presented of research in the following areas: Improvement of the Perfusion Apparatus Assembly; Frozen Cat Brain; Viability of the Brain Frozen for 777 days; Comparison of Cryoprotective Agents for Preservation of the Brain. TAB

N67-32879# Kanazawa Univ. (Japan). Dept. of Physiology.
NEURONAL ACTIVITIES ON THE REGULATION OF FEEDING Semiannual Progress Report
Yutaka Oomura San Francisco, Army Res. and Develop. Group, Far East, 1967 7 p
(Contract DA-JB17-67-C-0157)
(J-195-5; AD-651980) CFSTI: HC $3.00/MF $0.65

Experiments and date proceedings were carried out on analyses of single neuronal activities in the feeding (lateral hypothalamic area, LH) and satiety (ventromedial hypothalamic nucleus, VMH) centers in chronically unrestrained cats, and of single neuronal sensitivities on chemicals applied electrophoretically through a barreled electrode. Author (TAB)

N67-32905*# Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.
A PROSPECTIVE LOOK AT MEDICAL PROBLEMS FROM HAZARDS OF SPACE OPERATIONS
Douglas E. Busby Washington, NASA, Jul. 1967 446 p refs
(Contract NASr-115)
(NASA-CR-856) CFSTI: HC $3.00/MF $0.65 CSCL 06E

The report is oriented to missions during which the diagnosis and interim treatment of medical problems will have to be carried out in space. The clinical manifestations, diagnosis, and treatment of possible medical problems in space are covered. Various hazards of space operations are defined and analyzed in order to determine their possible medical effects. The pathophysiologic characteristics of medical problems are discussed to provide the rationale for the prevention and treatment of the problems in space. An effort is also made to provide a substantial bibliography for workers in clinical space medicine and to identify areas of research which will contribute to this field. The various effects of decompression and medical problems which could result from thermal stresses are discussed. Possible medical consequences of weightlessness are considered, along with those of particles traveling in space. Various traumatic injuries and medical problems produced by carbon dioxide are reviewed. The general aspects of the diagnosis and treatment of medical problems in space are covered. Author

N67-32906*# Southwest Research Inst., San Antonio, Tex.
[ASSIST IN ACCOMPLISHING THE TRANSFER OF APPLICABLE SCIENCE AND TECHNOLOGY FROM NASA'S R&D PROGRAM INTO THE BIO-MEDICAL FIELD] Quarterly Progress Report, 1 Mar.–31 May 1967
Ray W. Ware and Louis S. Berger 31 May 1967 92 p refs
(Contract NASr-94(09))
(NASA-CR-86990; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 06E

Continuing research projects in transferring aerospace technology to medical and biological applications are briefly summarized. Problem case histories are reported, and accepted abstracts are presented. Contributions to the information transfer processes are also covered. N.E.N.

N67-32912# Sao Paulo Univ. (Brazil). Center of Nuclear Medicine.
FIRST COURSE ON RADIATION PHYSIOPATHOLOGY: STUDIES OF EFFECTS OF IONIZING RADIATION ON LIFE ORGANISMS WITH SPECIAL REFERENCE TO MEN AND MAMMALS [PRIMEIRO CURSO LIVRE DE FISIOPATOLOGIA DAS RADIACOES (A ACAO DAS RADIACOES IONIZANTES SOBRE OS SERES VIVOS, COM ESPECIAL REFERENCIA AO HOMEM E AOS MAMIFEROS)]
Frederic Ludwig (Calif. Univ., San Francisco) 1966 22 p refs In PORTUGUESE
(CMN-Pub.-3/66)

The first course in radiation physiopathology is outlined. Course sections include fundamental concepts of damage induced by radiation, the effects of the atomic bomb, hematology of radiation leukemia resulting from radiation, delayed effects in radiation sickness, and aging as an experimental problem. Bibliographies are given for each section. NSA

N67-32917# Texas Christian Univ., Fort Worth. Inst. of Behavioral Research.
STRESS REVIEWS. II. THERMAL STRESS—HEAT
Marcia J. Duke, Nurhan Finolkyan, Joan Anderson, and S. B. Sells May 1967 67 p refs
(Contract Nonr-3436(00))
(TR-11; AD-652580) CFSTI: HC $3.00/MF $0.65

The physiological mechanisms of heat loss and heat gain are briefly described. Research in the area of performance under heat is extensively reviewed. Supportive and protective measures such as acclimatization, clothing, diet, training, and work load are emphasized. Author (TAB)

N67-32993*# Environmental Research Inst., Washington, D. C.
PHYSICAL LIMITATIONS OF LIFE Final Report, Jun. 1965–Jul. 1967
Frederick D. Sisler 15 Jul. 1967 14 p
(Contract NASr-244)
(NASA-CR-87159) CSCL 06F

Details are presented on experimental investigations on possible energy sources for microbial metabolism existing in the surface soil of Mars. The direct conversion of infrared energy to chemical energy and a method similar to the Seeback effect with solar radiation converted to electrical energy were studied. It was concluded that microorganisms may be present immediately below the crust. Experiments utilizing only infrared radiation were considered to be inconclusive. A technique based on the biochemical fuel cell principle was developed to measure cell metabolism by means of electric currents generated by metabolic activity. N.E.N.

N67-33033# School of Aerospace Medicine, Brooks AFB, Tex.
SEASONAL CHANGES AMONG ENDOCRINE–METABOLIC INDICES OF MEN RESIDING IN A SUBTROPICAL CLIMATE
Henry B. Hale, James P. Ellis, Jr., and Edgar W. Williams Dec. 1966 21 p refs
(AD-647620; SAM-TR-66-114) CFSTI: HC $3.00/MF $0.65

By means of urinalysis, seasonal changes in endocrine–metabolic activities were appraised in healthy men who, because of indoor occupations, had limited exposure to outdoor conditions. The study was conducted in San Antonio, Tex., where the subtropical climate allows outdoor activity in all seasons. Overnight urine specimens, which were collected once each week for a full year from 12 men, were analyzed for epinephrine, norepinephrine, 17-hydroxycorticosteroids, creatinine, urea, uric acid, phosphate, potassium, and sodium; and all of these urinary variables showed clear-cut cyclic shifting over the four seasons. In general, these endocrine–metabolic indices indicated inverse relationship to outdoor maximum temperature; and covariance analyses (with outdoor maximum temperature as the covariate) provided supporting evidence, indicating significant interrelationship for urinary variables and outdoor temperature. The urinary changes tended to lag behind the thermal changes, thereby indicating that temperature was not the sole factor involved. Heat-sensitivity, judging by these measures, was higher in spring than in summer. By expressing certain of the urinary constituents to creatinine, it is possible to correct for summer–winter differences but not for spring–autumn differences. Author (TAB)

N67-33086# California Univ., Berkeley. Lawrence Radiation Lab.
THE GEOMETRY AND ELECTRONIC STRUCTURE OF BIOLOGICALLY SIGNIFICANT MOLECULES AS OBSERVED BY NATURAL AND MAGNETIC OPTICAL ACTIVITY. I: PROTEIN CONFORMATION AND PLASTICITY. II: CHLOROPHYLL–CHLOROPHYLL INTERACTIONS. III: ELECTRONIC STRUCTURE OF METAL PORPHYRINS
Edward Alexander Dratz (Ph.D. Thesis) Sep. 1966 316 p refs
(Contract W-7405-ENG-48)
(UCRL-17200) CFSTI: HC $3.00/MF $0.65

Differences in the ultraviolet optical rotatory dispersion of the allosteric enzyme aspartate transcarbamylase, produced by effectors that alter its catalytic activity, appeared to reflect structural changes in the protein. These alterations of catalytic activity in response to the effectors, substrates, and inhibitors served an important metabolic control function in the cell. The conformational changes detected seemed to be related to the operation of the control function and may be important for an understanding of the mechanism of activity control in the enzyme. The observed changes were small but significant and were interpreted as a 5% decrease in helix content upon maximal activation of the enzyme by substrate. No substrate or inhibitor induced structural modifications were

detected in deoxycytidine monophosphate deaminase or in carboxydismutase. By the criteria of the measurements, the oxidized and the reduced forms of ceruloplasmin were observed to have identical conformation. The state of aggregation of chlorophylls in solution, in crystals and in photosynthetic particles is discussed. Evidence derived from circular dichroism (CD) and absorption spectra was used to propose a structure for the dimer of chlorophyll formed in nonbasic organic solvents. Chlorophyll a, chlorophyll b, and bacteriochlorophyll in vitro appeared to form dimers of similar structure under the conditions investigated. Aggregated chlorophyll exhibited a characteristically shaped, double CD spectrum in the long wavelength absorption band. The CD spectra of photosynthetic membrane fractions isolated from higher plants and photosynthetic bacteria suggested that some of the in vivo chlorophyll was aggregated. Investigations of membrane lamellae isolated from a mutant barley that contained no chlorophyll b revealed that chlorophyll a–chlorophyll a interactions were essentially independent of the presence of chlorophyll b, and that chlorophyll b–chlorophyll b interactions were present in the lamellae of normal barley. The CD spectrometer constructed for these measurements is described. The range of the instrument extended from 220 to 1200 millimicrons. Multiple spectrum averaging increased the ultimate sensitivity of CD measurements to 10^{-6} optical density units. A study of the magnetic circular dichroism (MCD) of porphyrins is presented. The physical basis of MCD is explained by a simple classical derivation. A semiclassical two-state model was developed to describe MCD quantitatively and to treat the influence of electron spin. The polarization of the electronic transitions in metal free protoporphyrin was assigned from the MCD spectrum. The MCD and absorption properties of zinc(II) porphyrins approached those expected for a free electron in a circular box. The magnetic field splits orbitally degenerated porphyrin excited states: For the zinc porphyrins, an orbital angular momentum of 6.5 was found in the lowest energy absorption band and 0.8 in the Soret band, whereas 9 and 1 were predicted by the free electron model. There was a more pronounced departure from the free electron model for other transition metal porphyrins. The orbital angular moments of the lowest energy bands were: copper(II), 6.0; silver(II), 5.3; nickel(II), 4.7; cobalt(II), 4.6; and iron(II), 4.0. A detailed interpretation of the metal porphyrin MCD was accomplished by the use of molecular orbital theory. MCD experiments on iron porphyrins and heme proteins indicated that the magnetic orbital splitting was sensitive to ligand coordination above and below the iron porphyrin plane. A brief evaluation of the possible future usefulness of MCD in chemistry and biology is included. Author (NSA)

N67-33111 Joint Publications Research Service, Washington, D. C.

COLLECTION AND INTERPRETATION OF METEOROLOGICAL DATA

28 Jun. 1967 40 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 194, 1966 p 16–21, 37–48, 92–101

(JPRS-41615; TT-67-32248) CFSTI: $3.00

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1. CRITICAL MONITORING OF AIR HUMIDITY DATA I. A. Berlin and L. F. Shkolyar p 1–8 refs (See N67-33112 19-04)

2. EXPERIMENTAL RESEARCH ON TURBULENCE IN THE GROUND SURFACE LAYER L. V. Dubrovin p 9–21 refs (See N67-33113 19-20)

3. ELECTRONIC GRAPHING DEVICE FOR AUTOMATIC PROCESSING OF RECORDED METEOROLOGICAL INFORMATION Yu. A. Kurpakov p 22–34 refs (See N67-33114 19-14)

N67-33112 Joint Publications Research Service, Washington, D. C.

CRITICAL MONITORING OF AIR HUMIDITY DATA

I. A. Berlin and L. F. Shkolyar *In its* Collection and Interpretation of Meteorol. Data 28 Jun. 1967 p 1–8 refs (See N67-33111 19-04)

Data are presented on the quantitative evaluation of the relationship between mean monthly values of air humidity in time and space. Preliminary conclusions are given on the feasibility of using the relationships obtained in the critical analysis of observation materials on electronic computers. Author

N67-33115# Office of Naval Research, Washington, D. C.

AN EXPERIMENTAL 45-DAY UNDERSEA SATURATION DIVE AT 205 FEET, SEALAB II PROJECT GROUP

D. C. Pauli and G. P. Clapper 8 Mar. 1967 44 p

(ONR-ACR-1245; AD-651999) CFSTI: HC $3.00/MF $0.65

Sealab II demonstrated that: The concept of ocean-floor habitation to accomplish a wide range of salvage and scientific tasks is compatible with man's ability to perform useful work at these depths; No significant short-time physiological changes occur which resulted in deterioration of the aquanauts physical condition; There is a degradation of human performance which increases with the complexity of the task being accomplished. TAB

N67-33143# Albert Einstein Medical Center, Philadelphia, Pa.

MECHANISM OF ACTION OF AET: THE PROTECTION OF DNA AGAINST IONIZING RADIATION BY GED Technical Report, 1 Sep. 1965–31 Aug. 1966

George Kollmann, Bernard Shapiro, and David Martin Brooks AFB, Texas, School of Aerospace Medicine, Jan. 1967 13 p refs

(Contract AF 41(609)-2637)

(SAM-TR-67-7; AD-648137) CFSTI: HC $3.00/MF $0.65

The specific viscosity was measured in unirradiated and irradiated solutions of highly polymerized, salmon sperm DNA alone and containing bis (2-guanidoethyl) disulfide (GED), oxidized glutathione (GSSG), cystamine, cadaverine, agmatine, and pentamethylene diguanidine (PMDG). Radiation-induced decrease in vicosity was almost completely prevented by .001 M GED up to 100 kR at which dose unprotected DNA solution viscosity approximated that of the solvent. When viscosity was measured at 90 degrees, to study the effect on single strands, radiation effect and GED protection of DNA were demonstrated with doses as low as 100 to 200 R. GED had to be present during irradiation for protection but could be removed by dialysis after irradiation without loss of protection. Equilibrium dialysis demonstrated binding of GED to DNA. Other disulfides, GSSG, and cystamine showed less binding to DNA and also showed less protection. The diamine cadaverine and the PMDG were bound to DNA as well as cystamine and GED, respectively, but showed no protection. The mechanism of action of GED appears to be a localized radical scavenging at the surface of the DNA molecule. Author (TAB)

N67-33144# Rutgers Univ., New Brunswick, N. J.

CAROTID AND FEMORAL ARTERY BLOOD FLOW IN HYPERTHERMIC CATS Technical Report, Aug. 1965–Apr. 1966

Edwin M. Nemoto and Harry M. Frankel Brooks AFB, Texas, School of Aerospace Medicine, Jan. 1967 13 p refs

(Contract AF 41(609)-2635)

(SAM-TR-67-1; AD-648130) CFSTI: HC $3.00/MF $0.65

Heart rate, mean arterial pressure, right atrial pressure, and blood flow in the femoral and in the carotid artery were monitored in cats whose rectal temperatures (T sub r) were raised to 44°C. Blood flows reached a maximum at T sub r 42° to 43°C, and vascular resistances in these beds reached minimum values in the same temperature range. Right atrial pressure remained

negative throughout the hyperthermic episode. The data support the view that circulatory failure found in extreme hyperthermia has a peripheral origin. Author (TAB)

N67-33154*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY WITH INDEXES, MAY 1967
Jun. 1967 144 p refs
(NASA-SP-7011(38)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

A compilation of abstracts and subject indexes is presented on references pertaining to the biological, physiological, psychological, and environmental effects to which man and organisms of lower order are subjected during actual or simulated flight or space flight. Consideration is also given to such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors. Corporate source and personal author indexes are included. M.G.J.

N67-33181# Florida Univ., Gainesville. Dept. of Physiology.
REGIONAL LACTIC ACID CONCENTRATION IN DOGS UNDER ACUTE HYPOXIA
David Oliver Westmark Brooks AFB, Tex., School of Aerospace Medicine, Sep. 1966 24 p refs
(Contracts AF 41(609)-2421; AF 41(609)-1553)
(SAM-TR-66-73; AD-643308) CFSTI: HC $3.00/MF $0.65

Large mongrel dogs were anesthetized with sodium pentobarbital and subjected to acute hypoxia. Blood samples were simultaneously withdrawn from several regions of the body and analyzed for lactate, PO2, PCO2, and pH in order to assess the acid-base status in relation to the level of oxygen tension, with special attention focused on regional lactic acid levels. The data accumulated and presented here show that the individual responses of animals subjected to these experimental conditions vary widely, but certain trends are evident. The lactic acid concentration was shown to vary inversely with the end-tidal PO2, with a sharp increase in lactate level occurring at end-tidal oxygen tensions below 50 to 60 mm. Hg. It was also shown that under conditions of severe hypoxia there is a marked difference in lactate concentration in blood samples simultaneously withdrawn from different regions of the body. The data suggest that some organ in the abdominal visceral circulation produces lactate at a rate considerably greater than that of resting muscle under these conditions, and that this disparity may result in a reversal of the normal venous-arterial lactate gradient, with muscle apparently removing lactate from the blood. Author (TAB)

N67-33255*# Beckman Instruments, Inc., Fullerton, Calif. Advanced Technology Operations.
DETECTION OF EXTRATERRESTRIAL MICROORGANISMS BY MICROCALORIMETRY Final Report
Nov. 1966 127 p refs Revised
(Contract NAS2-3477)
(NASA-CR-73044; FR-2425-102) CFSTI: HC $3.00/MF $0.65 CSCL 06M

An engineering feasibility and preliminary design study to delineate and specify the design parameters of a microcalorimetric system for the detection of Martian microorganisms was performed. Parameters considered were: (1) size, (2) weight, (3) power requirements, (4) thermal characteristics, (5) ambient temperature and pressure requirements, (6) interfacing with proposed surface sampling systems, (7) sample and nutrient requirements, (8) sample and nutrients manipulations, (9) programming, (10) interface capabilities and limitations, and (11) data output. A theoretical discussion of the key portions of a microcalorimeter is included, and an optimum system is proposed. Author

N67-33290# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TOXICOLOGICAL CHARACTERISTIC OF HYDRAZINE
N. K. Kulagina 20 Jan. 1967 26 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Toksikologiya Novykh Promyshlennykh Khim. Veshchestv, no. 1, 4, 1962 p 65–81
(FTD-HT-66-306; AD-653346) CFSTI: HC $3.00/MF $0.65

Lethal concentrations of hydrazine vapors are of the order of 1.0 to 2.0 mg/liter. Concentrations of the order of 0.5 to 0.8 mg/liter are sbreactive though they result in pronounced distrubances. A threshold concentration of hydrazine which produces minimal disturbances of the higher nervous activity of animals with a one-time application is a concentration of 0.02 mg/liter. It produces an increased irritability of the central nervous system. The clinical picture of acute hydrazine poisoning includes an irritating effect upon the mucuous membranes of the eyes, upper respiratory tracts and a general excitation, sometimes accompanied by convulsions. The morphological changes of the inner organs include extensive vascular disturbances, lung edema, and necrobiotic changes of the liver and kidneys. Prolonged exposure to hydrazine vapors in small concentrations may cause a chronic poisoning. The capability of hydrazine to penetrate the body through the skin and to produce a heavy and even lethal poisoning, as well as its capability to cause an acute skin irritation, and of the mucous membranes of the eye make it necessary to protect the skin and eyes from direct contact with hydrazine. TAB

N67-33359 National Institutes of Health, Bethesda, Md. Translating Unit.
AGE-RELATED CHARACTERISTICS IN THE PROPORTION OF HISTONES AND NUCLEIC ACIDS IN LIVER-CELL NUCLEI OF WHITE RATS AFTER PARTIAL HEPATECTOMY
A. I. Klimenko 1967 9 p refs Transl. into ENGLISH from the book "Materialy Sympozium Po Osnovym Problemam Vozrastnoi Fiziologii T. Biokahimi" Khar'Kov, Izat., 1964 p 94–96

The processes of protein synthesis in the regenerating liver of white rats were studied 28 to 36 hours after partial hepatectomy to determine the possible existence of age related characteristics in the proportion of histones and nucleic acids in liver cell nuclei. Experiments were performed on two age groups of animals of both sexes. The animals were one month old, and twenty-four months old, respectively. Results indicate that the process of regeneration is characterized by specific characteristics for each age group in the quantitative proportion of histones and DNA. In young animals at regeneration, the amount of the total histone remained at the same level as in the nuclei of liver cells of normal rats; however, the histone-1 fraction increased and the amount of histone-2 showed a sharp decline. In the nuclei of regenerating liver cells of older animals, the amount of the total histone was considerably reduced as evidenced by a decline in the amount of histone-1. The fraction of histone-2 at the level of regeneration increased. Regeneration also caused changes in the percentual proportion of the histone fraction. In the nuclei of liver cells of older animals at regeneration, a considerable decline occurred in the amount of histone-1 (of the arginine histone) per unit of DNA, which is a powerful inhibiter of protein synthesis. It is speculated that the high level of biosynthesis of protein in the regenerating liver of older animals may occur because, in consequence of the reduction of the amount of histone-1 per unit of DNA, the cistrons of DNA get an opportunity to synthesize in greater volume the information RNA and thus fulfill the function of the matrix for the creation of new protein molecules. In younger animals, regeneration likewise provoked changes in the proportion of histones and DNA in cellular liver nuclei; however, these changes were not linked with the role of the histone as inhibitors of protein synthesis. S.C.W.

N67-33380 Joint Publications Research Service, Washington, D. C.
MODELS OF BIOLOGICAL CATALYSTS

L. A. Nikolayev 17 Jul. 1967 22 p Transl. into ENGLISH from Priroda (Moscow), no. 1, Jan. 1967 p 47–56
(JPRS-41853; TT-67-32485) CFSTI: $3.00

Reviewed is the development of enzyme systems and the significance of modeling to future studies of dynamic biochemical structures. Examined are models of dehydrogenases, catalase, and certain oxidases and hydrolases. S.C.W.

N67-33394# Oak Ridge Associated Universities, Tenn.
TURNOVER COMPARTMENTALIZATION: A STATISTICAL TRACER THEORY FOR ANALYSIS OF WHOLE-SYSTEM RETENTION DATA
Per-Erik E. Bergner May 1967 36 p refs
(Contract AT-40-1-GEN-33)
(ORAU-104) CFSTI: HC $3.00

Physical problems related to the application of tracer methods in physiology are discussed. A tracer dynamics theory was constructed for metabolism studies using radioactive tracer methods. The metabolic pool is considered to be divided into compartments, and mathematical equations are presented to explain the theory for analysis of whole-system retention data. NSA

N67-33401 Joint Publications Research Service, Washington, D. C.
INFORMATION AND THE NERVOUS SYSTEM
Jiri Zeman 20 Jul. 1967 43 p refs Transl. into ENGLISH from the book "Poznani A Informace—Gnoseologicke Problemy Kybernetiky" Prague, 1962
(JPRS-41901; TT-67-32532) CFSTI: $3.00

Presented is a discussion of the role of the nervous system in conveying to the organism information concerning the environment which aids in maintaining an internal and external environmental balance. Several physiological hypotheses related to the problem of excitation energy during memorization are reviewed to show the interrelationship of information and energy. Included are analyses of the transformation of information in the nervous system; the form and characteristics of information received, processed, and stored by memory; the form of transferred information; information fixation in the memory; and information and the psychophysical problem. S.C.W.

N67-33408*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SURVIVAL OF SELECTED MICROORGANISMS IN HIGH ULTRAVIOLET FLUX
Jean W. Mardres Dec. 1966 12 p refs
(NASA-TM-X-55853; X-624-66-189) CFSTI: HC $3.00/MF $0.65
CSCL 06F

A survey of the survival times of selected microorganisms exposed to ultraviolet radiation in doses at a flux equivalent to that received on the Martian surface is reported. Model ultraviolet lamps with 98% radiation output at 2537 Å were set up in a plastic enclosure 14 inches from the sample exposure surface. Intensity of the radiation was approximately 80μ w/cm^2 at a distance of 14 inches. Organisms used consisted of *Bacillus subtilis var. niger; Brevibacterium helvolum; Norcardia asteroides; Streptomyces griseus; Rhodotorula glutinis; Aspergillus niger; Cladosporium resinae; Alternaria Brassicola; Penicillium notatum;* and *Hormodendrum hordei*. The usual phenomen observed in sterilization studies with microbes is a logarithmic order of death. Data presented show that, in all but one case *Brevibacterium helvolum*, this phenomenon is not observed, or only partially observed. Most of the other species exhibit a definite plateau where the number of survivors remains relatively constant. The bacteria, actinomycetes, and yeast showed very short survival times and no further studies are planned to quantitate the results. The fungi, on the other hand, demonstrated substantial resistance to UV, and further studies of the morphological and physiological characteristics of these organisms are recommended in an attempt to identify the protective mechanism(s). All fungi studied were Deuteromycetes (Fungi Imperfecti). S.C.W.

N67-33451 Joint Publications Research Service, Washington, D. C.
MAN'S PHYSICAL ENDURANCE AND ITS DEVELOPMENT
Yakov Anan'yevich Yegolinskiy, V. I. Pakhov, N. N. Kokina, and G. I. Chernakova, ed 19 Jun. 1967 47 p ref Transl. into ENGLISH from the book "Fizicheskaya Vynoslivost Cheloveka i Puti Yeye Razvitiya" Moscow, Min. of Defense, 1966 p 3–31, 72–79, 112–116 Revised
(JPRS-41-444; TT-67-32077) CFSTI: $3.00

The nature and various aspects of man's physical endurance are discussed, and methods of developing endurance for different types of warfare are considered. The general problem of endurance during military action is treated, as are methods for conditioning endurance. M.W.R.

N67-33496# Albert Einstein Medical Center, Philadelphia, Pa.
RELATIONSHIP BETWEEN FUNCTION AND METABOLIC ACTIVITY OF HEART IN SITES Final Report
Clem Russ 1967 17 p
(Contract AF 41(609)-3137)
(AD-653221) CFSTI: HC $3.00/MF $0.65

The results of the studies indicate that oxidative processes of the hypothermic myocardium shifts toward utilization exclusively of non-esterified fatty acids after 24 hours. This shift in metabolism appears to be associated with a rise in myocardial internal efficiency and a fall in external efficiency. These changes represent what might be considered a disturbance in energy production. Energy production in heart muscle as well as skeletal muscle involves the oxidation of food stuff to carbon dioxide and water. The primary substrates, glucose, lactate, pyruvate and non-esterified fatty acids are passed through a series of intermediary reactions during which energy is liberated and subsequently utilized to perform mechanical work. This energy is derived through the oxidation processes within the Krebs' cycle or tricarboxylic acid cycle, the final common pathways for oxidation of all food stuffs. Author (TAB)

N67-33499# Dartmouth Coll., Hanover, N. H.
UNCERTAINTY AS A MOTIVATING VARIABLE
John T. Lanzetta 1967 27 p Presented at the Conf. on Exptl. Social Psychology, Vienna, Apr. 1967
(Contracts AF 49(638)-1441; Nonr-3897(07))
(AD-652413) CFSTI: HC $3.00/MF $0.65

An individual is uncertain when a situation elicits response alternatives no one of which is overwhelmingly dominant and his degree of uncertainty is a function both of the number of competing responses elicited by the situation and the relative response strength of the competing alternatives. Uncertainty of more than moderate degree is aversive. When uncertain an organism is motivated to behavior which in the past has been instrumental in reducing uncertainty. Responses which expose the organism to new information have a long history of association with attenuation of uncertainty and thus have a high probability of being evoked in uncertain situations. Since uncertainty functions as a drive and information intake is the primary means for reducing uncertainty, an increase in uncertainty should produce an increase in the strength of responses which facilitate information acquisition. Using several different means of manipulating uncertainty and several measures of the strength of information acquisition the studies reported strongly support this hypothesized relationship. This was true whether or not the information permitted selection of a response with some instrumental value, e.g., gaining a reward or avoiding a punishment. Author (TAB)

N67-33563# Sandia Corp., Albuquerque, N. Mex.
RADIOLOGICAL HEALTH ASPECTS OF THULIUM-170, THULIUM-171 OXIDE
R. J. Everett Feb. 1967 30 p refs
(Contract AT(29-1)-789)
(SC-RR-66-2679) CFSTI: HC $3.00/MF $0.65

Thulium-170, -171 oxide is examined as to properties and consequences of human exposure. Properties are listed that relate to the radiation hazard. Dose and effect relationships are proposed based upon presently available data. Specific biological data about thulium are quite rare; however, reasonable predictions are made by using data on stable rare earth compounds and general models for deposition and retention. Dose comparisons are made between thulium and other insoluble fuel materials to assist in fuel selection. Thulium compares favorably with most fuel materials, but suffers somewhat from low power output and, therefore, incurs some weight penalty. It is noted that the properties of an isotope that make it a desirable thermoelectric fuel material for terrestrial and space application also contribute directly to its biological hazard; however, individual physical and chemical properties often reduce the hazard or lower the probability of interaction with humans.
Author (NSA)

N67-33571# Florida Presbyterian Coll., St. Petersburg Neuro-Sciences Lab.
PERCEIVED STRESS, PERFORMANCE, PERSONALITY AND BIOCHEMICAL FACTORS IN HUMANS Final Report, 1 Apr. 1965–31 Oct. 1966
W. F. Angermeier and E. I. Stevens Holloman AFB, N. Mex., ARL May 1967 129 p refs
(Contract AF 29(600)-5135)
(ARL-TR-67-11; AD-653973) CFSTI: HC $3.00/MF $0.65

A study was made to investigate perceived stress, performance, personality and biochemical factors in humans. A total of 250 naive human subjects, both males and females, white and colored, ranging in age from 15 to 22 years were used as subjects to study possible relationships which might exist between (1) perceived stress, (2) personality factors as they appear on the California Psychological Inventory, (3) IQ as measured by the Otis Test, (4) a match-to-sample block test, (5) an analogy problem solving test under stress, (6) change in pupil size, (7) change in heart rate under stress, and (8) galvanic skin response during and after sound-shock conditioning. Possible biochemical differences as they may exist among various subgroups and their possible modification by a program of cultural, perceptual, and dietary enrichment were also investigated.
Author (TAB)

N67-33589 Joint Publications Research Service, Washington, D. C.
EFFECT OF PHYSICAL EXERTION ON THE HUMAN ORGANISM
15 Jun. 1967 17 p Transl. into ENGLISH from Fizkul' Tura i Spor (Kalinin), no. 4, Apr. 1967 p 27–31
(JPRS-41402; T-67-32036) CFSTI: $3.00

CONTENTS:

1. MOUNTAIN SICKNESS A. L. Chizhevskiy p 1–7 (See N67-33590 19-04)
2. SECRETS OF THE BRAIN A. Obysov p 8–15 (See N67-33591 19-04)

N67-33590 Joint Publications Research Service, Washington, D. C.
MOUNTAIN SICKNESS
A. L. Chizhevskiy *In its* Effect of Phys. Exertion on the Human Organism 15 Jun. 1967 p 1–7 (See N67-33589 19-04)

The subject of this article is the causal connection between mountain sickness and ionization of the air. The symptoms of mountain sickness are given as labored breathing, strong heart beat, nausea sometimes ending in vomiting, cyanosis of the face and hands as in asphyxiation, loss of strength, noise in the ears, dimming of vision, inability to do work, and finally, fainting. Earlier hypotheses regarding the cause of the sickness are recounted, and an account is given of the first experiment to establish proof that extreme positive ionization of the air causes the sickness. In addition to a description of this experiment, which was conducted in 1901 in the Swiss Alps, later work is briefly cited in which the occurrence of mountain sickness in the Crimea is linked to a predominance of positive over negative ions in otherwise normal air.
K.W.

N67-33591 Joint Publications Research Service, Washington, D. C.
SECRETS OF THE BRAIN
A. Obysov *In its* Effect of Phys. Exertion on the Human Organism 15 Jun. 1967 p 8–15 (See N67-33589 19-04)

Discussed is the diversity of function of the human brain, its accuracy, reliability, and capacity for adapting to various changes in the environment and internal features of the body. The role of persistent and systematic training in improving the functioning of the central nervous system is pointed out. A brief, nontechnical description is given of the cerebral cortex, the nerve fibers, and the two basic processes characterizing the function of the nerve cell, i.e. excitation and inhibition. In general, the subject is discussed in the context of physical education and training.
K.W.

N67-33624 Joint Publications Research Service, Washington, D. C.
CONTROL OF MOVEMENTS IN MAN
L. S. Aleyev and S. G. Bunimovich 15 Jun. 1967 16 p refs Transl. into ENGLISH from the book "Modelirovaniye v Biologii i Meditsine" Kiev, Izd. Naukova Dumka, 1966 p 34–40, 142–149
(JPRS-41403; TT-67-32037) CFSTI: $3.00

CONTENTS:

1. FEEDBACK IN A BIOELECTRIC SYSTEM FOR CONTROLLING MOVEMENTS IN MAN L. S. Aleyev and S. G. Bunimovich p 1–6 refs (See N67-33625 19-04)
2. CONTROL OF HUMAN MOVEMENTS BY DIRECT ACTION ON THE NEUROMUSCULAR APPARATUS L. S. Aleyev, V. I. Zborovskiy, and S. G. Bunimovich p 7–13 refs (See N67-33626 19-04)

N67-33625 Joint Publications Research Service, Washington, D. C.
FEEDBACK IN A BIOELECTRIC SYSTEM FOR CONTROLLING MOVEMENTS IN MAN
L. S. Aleyev and S. G. Bunimovich *In its* Control of Movements in Man 15 Jun. 1967 p 1–6 refs (See N67-33624 19-04)

Devices and systems of controlling motor reaction in living organisms are briefly reviewed. It is pointed out that a major shortcoming is the lack of control over the neuromuscular groups. The problems associated with providing feedback in the device to counteract or control the corrective action, which the organism takes due to its own natural feedback, are mentioned. A bioelectrolocation method is described, and a block diagram is included of a multichannel control device with feedback circuits of the bioelectrolocation type.
N.E.N.

N67-33626 Joint Publications Research Service, Washington, D. C.
CONTROL OF HUMAN MOVEMENTS BY DIRECT ACTION ON THE NEUROMUSCULAR APPARATUS

L. S. Aleyev, V. I. Zborovskiy, and S. G. Bunimovich *In its* Control of Movements in Man 15 Jun. 1967 p 7–13 refs (See N67-33624 19-04)

A multichannel electronic control device for stimulating human movements by direct action on the neuromuscular apparatus is described briefly. Myopotentials arising during deliberate movements are used as input signals in a computer. The compensatory mechanisms in the central nervous system, and the shape, size, and emplacement of the bioelectrodes are also described. Experiments performed on healthy subjects are mentioned, and it was found advantageous to act simultaneously on two or more muscles participating in a given movement. N.E.N.

N67-33631# Technology, Inc., San Antonio, Tex. Life Sciences Div.

EYE EFFECTS MATHEMATICAL MODELS, 1 JUN. 1966–31 MAY 1967

Arthur F. Muller and Patrick W. Wilson, Jr. Jul. 1967 23 p refs

(Contract AF 41(609)-3079)

(AD-653984) CFSTI: HC $3.00/MF $0.65

The report describes the results of research to develop mathematical models of eye effects produced by nuclear flashes. The model for prediction of retinal burns gives temperature values by using a numerical method to approximate the solution of a differential equation governing the conduction of heat in the ocular fundus. Consideration is given to the validity of the solution by discussing the convergence, stability, and accuracy of the numerical method. Comments are given on a statistical model for the prediction of flashblindness recovery times. Author (TAB)

N67-33714# Scandinavian Airlines System, Oslo (Norway).

THE ^{137}Cs BODY BURDEN OF CIVILIAN PILOTS

Aksel Stroemme (State Inst. of Radiation Hygiene, Oslo), and Birger Hannisdahl [1968] 4 p Presented at Intern. Meeting on Aerospace Med., Sydney, 28 Nov.–1 Dec. 1966

(Contract AT(30-1)-3364)

(NYO-3364-32; CONF-661120-1) CFSTI: HC $3.00/MF $0.65

During the last few years there has been considerable interest in the study of the body burden of radioactive contaminants of aircraft personnel. So far the measurements have mainly been carried out on military personnel with the consequence that little is known about the radioactive body burden of civilian pilots. The radioisotopes of interest are those which originate from nuclear weapons tests in the atmosphere. Of these the easiest to study in the human body are the gamma-emitters of which the two most important are ^{131}I and ^{137}Cs. Because ^{137}Cs has a relatively long half-life it is more suitable for studies over a long period of time than ^{131}I that has a short half-life. Therefore, during 1964, 1965, and 1966 several examinations of Norwegian pilots were performed. The pilots were measured in steel chambers with the background radiation reduced to 1% of the level outside the chamber. It was concluded that ^{137}Cs body burden of the pilots was about the same as the body burdens of other male residents of Oslo, and much lower than the body burdens of some of other groups of the Norwegian population. It was also concluded that flights at less than 30,000 feet were of little risk as far as radioactive fallout was concerned. NSA

N67-33735 Joint Publications Research Service, Washington, D. C.

OPHTHALMOSCOPY IN INDIRECT LIGHT

A. M. Vodovozov 15 Jun. 1967 13 p refs Trans. into ENGLISH from Vestn. Oftalmol. (Moscow), Jul.–Aug. 1965 p 42–48

(JPRS-41401; TT-67-32035) CFSTI: $3.00

Equipment and procedures for ophthalmoscopy in indirect light were developed, and limitations and capabilities of the method were determined. Since the method was found to be particularly useful in cases involving cystoid dystrophy of the retina, drusen of the retina and optic nerve, lesions in the choroid, and pigmented formations on the eye; and some general observations are reported for eye examinations using ophthalmoscopy. M.W.R.

N67-33769# Naval Research Lab., Washington, D. C.

RECENT EXPERIMENTS WITH *CHLORELLA*

P. J. Hannan, R. L. Shuler, and C. Patouillet *In its* The Present Status of Chem. Res. in Atmosphere Purification and Control on Nucl.-Powered Submarines 11 Jan. 1967 p 40–48 refs (See N67-33761 19-05)

Reviewed are experiments designed to determine the potential of mass cultures of algae as a source of oxygen for submarines and for eliminating carbon dioxide. Efforts to develop an algal gas exchanger (*Chlorella pyrenoidosa*) are reported. Problems investigated included studies of the tendency of algal cells to stick to glass surfaces; the effects of bacteria on sticking of cells; and respiration. It is concluded that an algal gas exchanger can be a reliable system for oxygen generation and CO_2 absorption on a nuclear submarine; however, its most serious deficiency, the high electrical power requirement of 30 to 32 kw per man, precludes further consideration. These estimates are based on the use of incandescent lamps whose efficiency is only ten percent; a breakthrough in lighting technology could alter the power requirement significantly. Problem areas requiring further investigation prior to engineering development of the system such as: sticking of cells, matching the respiratory quotient of man to the assimilatory quotient of algae; hydrocarbon vapors and aerosols; and the re-use of culture media salvaged from cell suspensions; are also discussed. S.C.W.

N67-33827* Joint Publications Research Service, Washington, D. C.

HUNGARIAN STUDY OF THE COMBINED PROPAGATION OF UNICELLUAR ALGAE AND BACTERIA

Gyula Weiszfeiler, Istvan Toth, and Gyorgy Biro 15 Jun. 1967 10 p refs Transl. into ENGLISH from Hidrol. Kozl. (Budapest), v. 47, no. 1, Jan. 1967 p 41–43

(JPRS-41404; TT-67-32038) CFSTI: $3.00

The propagation of *Chlorella pyrenoidosa* and other algae and bacteria strains in sewage water under controlled temperature conditions, was studied. Very intensive propagation occurred at 24°C, and propagation at 37°C was satisfactory. The fast propagation of other species in the nutrient urea solution was considered to be due to a favorable biological coexistence with Chlorella. Results indicate that *Chlorella pyrenoidosa* strain No. 9192 proves suitable for propagation along with bacteria in the presence of urea as the only organic material. L.S.

N67-33837*# School of Aerospace Medicine, Brooks AFB, Tex.

A DETAILED STUDY OF CONTAMINANTS PRODUCED BY MAN IN A SPACE CABIN SIMULATOR AT 760 mm. Hg Final Report

J. P. Conkle, W. E. Mabson, J. D. Adams, H. J. Zeft, and B. E. Welch Mar. 1967 149 p refs

(NASA Order R-89)

(NASA-CR-87451; SAM-TR-67-16; AD-653932) CFSTI: HC $3.00/MF $0.65 CSCL 06K

A 27-day experiment was conducted to determine man's contribution to trace contaminants in a sealed environment. An environmental test cell was maintained at a total pressure of 760 mm. Hg throughout the 27 days, with the first 13 days being unmanned and the last 14 days being manned. Four subjects were utilized during the 14-day manned portion of the test. During the 27 days, 97 compounds were identified and quantified; 21 of these compounds were noted only during the manned portion of

the study. Direct contaminant analysis of the sealed environment was not adequate for this type of comprehensive survey. Cryogenic fractionation and concentration, however, provided samples with sufficient concentration of contaminants for analysis by means of gas chromatography, infrared spectroscopy and mass spectroscopy. Carbon monoxide and carbon dioxide were compounds that were produced by man and identified in this experiment and that would require removal during the 14-day period. Author (TAB)

N67-33852 Joint Publications Research Service, Washington, D. C.

VITAL STAINING OF THE MUSCLE TISSUE DURING EXCITATION

I. P. Suzdal'skaya 21 Jul. 1967 11 p refs Transl. into ENGLISH from Tsitologiya (Moscow), v. 6, no. 2 1964 p 196–200
(JPRS-41938; TT-67-32569) CFSTI: $3.00

In order to examine the properties of the muscle tissues of warm-blooded animals during rest and excitation, a number of acid and base stains were used in the diaphragm preparation of white rats. The diaphragm muscles exhibited an increased sorption of basic stains (neutral red and rhodamine) and an absence in the fixation of acid stains (cyanol, acid fuchsin, and phenyl red) during electric stimulation of the phrenic nerve. These results are in agreement with previous data obtained on frogs, and indicate muscle protein alterations from the action of adequate stimuli. M.W.R.

N67-33869* New England Medical Center Hospitals, Boston, Mass.

BIOMAGNETISM AND FERRITIN Semiannual Report

Peter W. Neurath and Ellen G. Resnick 1 Aug. 1967 12 p
(Grant NGR-22-021-002)
(NASA-CR-87274) CFSTI: HC $3.00/MF $0.65 CSCL 06F

Efforts during this period showed a pronounced decrease in the embryonic development of fertilized eggs of *Rana pipiens* at an early stage due to the gradient magnetic field. Only 30.2% of the eggs hatched as compared with 55.4% of the control. However, the overall results have enough variability to provide only a low level of significance. Improvements in experimental technique had to be made during the runs because of certain physical problems. The embryos from these experiments are being examined histologically and chemically to determine the nature of the arrested development. R.N.A.

N67-33889# Gottingen Univ. (West Germany). Institut fuer Medizinische Physik und Biophysik.

INVESTIGATIONS ON NUCLEOHISTONES [UNTERSUCHUNGEN AN NUCLEOHISTONEN]

E. Harbers Bad Godesberg, W. Germany, Bundesmin. fuer Wiss. Forschung, Nov. 1966 14 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Wiss. Forschung
(BMWF-FBK-66-36)

After a short introduction to the need for information on somatic cells, various methodical investigations of the isolation of nucleohistones and their fractionation into euchromatin and heterochromatin are reported. In model experiments with nucleohistones isolated from Ehrlich ascites tumor cells, X-rays caused a decrease in the template activity for RNA–polymerase; pure DNA was found to have a higher radiosensitivity. Studies with labeled actinomycin showed that the ratio of bound actinomycin per DNA was considerably higher in euchromatin as compared to heterochromatin. In tumor cells the portion of euchromatin was lower than in normal tissues; tumor induction in the rat liver by diethyl–nitrosamine also caused a decrease in the amount of euchromatin. These observations discussed with respect to the problem of carcinogenesis. Author (NSA)

N67-33890# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

PROBLEMS IN AERIAL APPLICATION: HISTOCHEMISTRY OF WEIL STAIN ON LIVER

George Clark Nov. 1966 6 p refs
(AM-66-26) CFSTI: $3.00

Techniques for acetylation, methylation, deamination, and aldehyde blockage were rigorously followed in Weil staining of rat liver; and the livers of rats perfused with acacia saline followed by acacia formalin fixation were embedded in paraffin and sectioned at seven microns. Small blocks of liver that were rapidly excised from decapitated rats were treated and kept for one week at −20°C, and subsequently treated in the same way as the unextracted blocks. Intensity of the stain was increased with methylation, aldehyde blockage, acetylation, paratoluene, sulfonic acid, and trichloroacetic acid. Deamination for 30 min or 24 hr resulted in decreased staining intensity as did amine blockage with the ammonium salt of rhodanilic acid. All the lipid solvents used markedly decreased the staining intensity of liver cytoplasm. It is suggested that the compound which decreases in cold adaptation but increases in poisoning with halogenated hydrocarbons is a phospholipid containing a secondary amine, which is the functional group to which the Weil stain attaches in both the liver and the spinal cord. M.W.R.

N67-33958 Joint Publications Research Service, Washington, D. C.

LUMINESCENT–MICROSCOPIC STUDY OF DENERVATED MUSCLES

L. G. Filatova and I. G. Shtrankfel'd 20 Jul. 1967 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Biofiz. (Moscow), v. 157, no. 5, 1964 p 1228–1230
(JPRS-41904; TT-67-32535) CFSTI: $3.00

Luminescent-microscopy of fixed and vital preparations of muscle fibers stained with acridine orange was used at various periods following denervation during the development of the atrophic process in the sciatic nerve of the frog. Paraffinized sections and fluorochromed muscle fibers were investigated. Characteristic differences in intensity luminescence of elements with transversostriated structure was observed; and it is assumed that acridine orange is capable of forming complexes with muscle proteins and that this capacity varies with different proteins. During intravital observations of the luminescence of muscle fibers at early periods of denervation, the red granulations which disappear in the destroyed fibers are clearly visible. The use of vital fluorochroming permits the observation of the dynamics of structural changes from the content of the red granules. M.W.R.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-32710# School of Aerospace Medicine, Brooks AFB, Tex.

FURTHER MODIFICATION OF THE CARLSON–CRITTENDEN DEVICE FOR THE COLLECTION OF HUMAN PAROTID FLUID Report for Dec. 1964–Feb. 1966

Ira L. Shannon Feb. 1967 12 p refs
(SAM-TR-67-19; AD-652205) CFSTI: HC $3.00/MF $0.65

An improved device is described for the collection of human parotid fluid. The greatest improvement is the provision of a much larger suction area with a resultant higher degree of cup stability. Directions are given for fabrication, cleaning, and sterilizing the apparatus. Author (TAB)

N67-32839# Illinois Univ., Urbana. Dept. of Psychology.
A FORTRAN II PROGRAM FOR THREE-MODE FACTOR ANALYSIS
Robert L. Linn, Frank W. Snyder, Mark I. Applebaum, and Ledyard R. Tucker Mar. 1967 41 p ref
(Contracts Nonr-1834(39); N00014-66-C0010A03)
(AD-653100) CFSTI: HC $3.00/MF $0.65

A FORTRAN II program for Method III (large numbers of individuals in the sample) of three-mode factor analysis is presented. A description of the method of use of the program is given along with graphical representations of the data matrix and the sequencing of cards. A complete listing of the FORTRAN II card deck is also given. Author (TAB)

N67-32867# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.
DEVELOPMENT OF HIGH CONTRAST ELECTROLUMINESCENT DISPLAYS Final Report, 1 May 1965–1 Dec. 1966
Sidney V. Petertyl, Paul R. Fuller, Chester A. Wysocki et al Mar. 1967 78 p refs
(Contract AF 33(615)-2841)
(GRR-67-1268; AFFDL-TR-66-183; AD-652496) CFSTI: HC $3.00/MF $0.65

This report describes the development, characterization, and human factors evaluation of high visibility electroluminescent displays. Through the development of a greatly improved contrast filter technique and its combination with anti-reflection coatings, it is shown that daylight aircraft cockpit EL displays can be made. The importance of both specular and diffuse reflections are illustrated. A dramatic reduction in the display brightness required for the threshold of rapid readability has been achieved. Improving display visibility by use of high contrast rather than high brightness means that electrical power dissipation for the display can be reduced, and useful display life increased. Author (TAB)

N67-32870# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
STUDIES IN RESEARCH METHODOLOGY. VII: THE CENTRAL LIMIT EFFECT FOR TWO DOZEN POPULATIONS AND ITS CORRELATION WITH POPULATION MOMENTS Final Report, Dec. 1964–Oct. 1966
James V. Bradley Dec. 1966 88 p refs
(AMRL-TR-66-242; AD-653189) CFSTI: HC $3.00/MF $0.65

The report shows the Central Limit Effect upon the sample mean for samples from each of 24 populations. The exact shape of each population is shown graphically and its standardized central moments are given. Along with each population is shown the nonrobustness of its sample mean at both left and right tailed nominal alphas of .50, .40, .30, .20, .10, .05, .025, .01, .005, .001, and .0005 for Ns of 2, 4, 8, 16, 32, 64, 128, 256, 512, and 1024, thus depicting the Central Limit Effect in considerable detail. It is shown that the nonrobustness of the sample mean is strongly correlated with the departure of the 3rd and 4th standardized central moments of the sampled populations from their values for a normal distribution. When the population is appreciably asymmetric, the correlation with the 3rd moment tends to be extremely strong, especially when N is moderately large. Author (TAB)

N67-32874# Magna Corp., Anaheim, Calif.
THIN FILM PERSONAL DOSIMETERS FOR DETECTING TOXIC PROPELLANTS Final Report, 15 Apr. 1964–15 Apr. 1965
C. R. Townsend, G. A. Giarruso, and H. P. Silverman Wright-Patterson AFB, Ohio, AMRL, Feb. 1967 71 p
(Contract AF 33(615)-1751)
(TRW-6302-6001-R0000; AMRL-TR-66-231; AD-652849) CFSTI: HC $3.00/MF $0.65

The subject of this report is the development of a portable system for the detection of low concentrations of nitrogen tetroxide (N_2O_4), fluorine (F_2), and unsymmetrical dimethylhydrazine (UDMH) in air. The detection system is based upon the change of electrical resistivity of thin metal films when exposed to these gases. Silver metal films coated with appropriate salts proved to be applicable to the detection of all three gases; however, the following sensitized metal films were found to be optimum: for N_2O_4, silver; for F_2, copper; and for UDMH, gold. Using the best film and salt combinations found to date, N_2O_4 could be monitored over the range of 0.1 to 50 ppm, F_2 over the range 1.0 to 50 ppm, and UDMH over the range 10 to 100 ppm, with a standard deviation of about 20 percent. The effects of temperature over the range 50 to 90°C and of humidity from 10 to 90 percent on the response characteristics of the thin film sensors were found to be significant but within the tolerance limits. Means for reducing these effects were suggested which, if successful, would, in effect, make this detection system practically independent of changes in the environment. A portable breadboard readout instrument was designed and fabricated for use with the sensors to form an integrated detection system for personal protection. Author (TAB)

N67-32916# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
EFFECTS OF BLUE CUTOFF FILTERS ON COLOR DISCRIMINATION
Gloria T. Chisum, Kathryn B. Trent, and Phyllis E. Morway 3 Apr. 1967 35 p refs
(NADC-MR-6704; AD-652377) CFSTI: HC $3.00/MF $0.65

The effects on color discrimination of three blue cutoff filters used in simulated photochromic flashblindness protective goggles were evaluated under simulated cockpit red and white lighting. Seventy observers, including eleven flight personnel, participated in the evaluations. The following conclusions and recommendations are based on the results of this study: Under similar lighting conditions, color discriminations through the three blue cutoff filters evaluated are not substantially different. The greatest difference in color discriminability occurs across conditions of chromatic and achromatic lighting. The degree of protection provided by a photochromic goggle is the only factor evaluated to date which varies among the three filters. On the basis of the degree of protection provided the goggle with a 45% open transmission with an attainable closed density of 3.5 is the most satisfactory. The open transmission of the goggle should be increased. The attainable closed density should be maintained at 3.5 or better. Author (TAB)

N67-32991# Northrop Space Labs., Hawthorne, Calif. Space Materials Lab.
RESEARCH ON CLOSED-CELL SPONGE AS A PRESSURE TECHNIQUE FOR PROTECTIVE ASSEMBLIES Final Report, 10 May 1965–5 Jul. 1966
R. M. Heitz and G. W. Jones Feb. 1967 74 p refs
(Contract AF 33(615)-2953)
(AMRL-TR-66-183; AD-652853) CFSTI: HC $3.00/MF $0.65

A closed-cell foam was developed for integration into a partial pressure suit that would produce pressure on the human body to provide protection in a vacuum environment. A survey of literature and industrial organizations was followed by an extensive experimental study on known foam systems and the development of new foam systems. The evaluation and development of the foam composition and processing techniques are described. From this study, the formulation and processing of suitable vinyl closed-cell foams were developed with reproducible properties in controlled processes. Their physical properties passed successfully the required cycling test wherein the foams, properly restrained and exposed to vacuum, exerted a pressure response of 7 psia or 3.5 psia depending upon the process used. Author (TAB)

N67-33089# State Univ. of New York at Buffalo.
ROBUSTNESS OF TESTS
In its Some Topics Related to Transformations, Distribution Functions and Stochastic Processes Nov. 1966 p 47–62 refs (See N67-33086 19-19)

Presented is an illustration of the notion of robustness of a test, a generalization of this notion, and a tentative definition of the robustness of a test in terms of a metric on the space of power functions of the test. A short investigation is also made of the properties of the Kolmogorov metric on the space of location families of distribution functions, and applications are made to the normal, Cauchy, student's-t, gamma, and exponential distributions. Author

N67-33108# Litton Systems, Inc., Beverly Hills, Calif. Space Sciences Labs.
RESEARCH AND DEVELOPMENT OF HELMET FACEPIECES FOR SPARE PROTECTIVE ASSEMBLIES Final Report, 30 Jun. 1964–30 Dec. 1965
R. M. Rocco Jan. 1967 116 p ref *Its* Publ. No. 4832
(Contract AF 33(615)-1874)
(AMRL-TR-66-193; AD-652248) CFSTI: HC $3.00/MF $0.65

The research and development of an aspherical glass facepiece for a full pressure spacesuit compatible with AF helmet AP-22F-2, capable of protecting an astronaut from hazards of space during a 4-hour extravehicular mission are described. The transparency was to remain fog-free during a condition of zero air flow and 100 percent relative humidity. In addition, facepiece design was to provide sufficient attenuation of solar electromagnetic radiation to assure an astronaut mean facial skin temperature not in excess of 100F. Initial effort was directed toward definition of the extreme space environments for the defined orbit. These environments were simulated in the laboratory for compatibility testing of candidate materials (glasses, optical coatings, and electrically conductive coatings). Additional tests were devised to investigate the effectiveness of anti-fog devices and solar reflective coatings. Test results indicate that, for the particular facepiece configuration and internal and external spacesuit environments defined, a power dissipation of 0.33 watt/sq in is required to maintain a fog-free facepiece; and a mean facial skin temperature of 100F will not be exceeded provided the solar radiation incident on the astronauts skin is not greater than 0.43 solar constant. Facepiece materials were selected from candidates which satisfactorily withstood the extreme environmental tests. Author (TAB)

N67-33156# Joint Publications Research Service, Washington, D. C.
CYBERNETICS APPLICATIONS IN SPORTS TRAINING
G. Yelenskij *In its* Current Appl. of Cybernetics in the USSR 28 Jun. 1967 p 1–6 Transl. into ENGLISH from Tekhn. Molodezhi (Moscow), no. 4, 1967 p 36–37 (See N67-33155 19-05)

Methods and equipment for analyzing motion in sports are briefly discussed, and three examples of practical application are given: (1) use of a speedograph and a kinocyclograph to measure the velocity of a table tennis ball when struck by the paddle; (2) development of an equation, a mathematical model, and electronic processing for the motion of a gymnast when performing the giant swing on the crossbar; and (3) an autotrainer data sensing device which is attached to the skates of figure skaters to indicate faulty position of the skates during required-program exercises. K.W.

N67-33159*# Farnham (Frank C.) Co., Philadelphia, Pa.
INTRODUCTION TO MEDICAL CYBERNETICS
V. V. Parin and R. M. Bayevskiy Washington, NASA, Jul. 1967 227 p refs Transl. into ENGLISH of the book "Vvedeniye v Meditsinskvyu Kibernetkku" Moscow, Izdatelstvo Meditsina, 1966
(Contract NASw-1497)
(NASA-TT-F-459) CFSTI: HC $3.00/MF $0.65 CSCL 06D

Theoretical cybernetics, which studies problems related to the common mathematical description of control processes, is discussed in terms of information, automatic control, and algorithm theories. Consideration is also given to the general questions of biocybernetics; cybernetics of cellular and subcellular structures, and of physiological systems; neurocybernetics; problems and the peculiarities of man–machine systems. Attention is centered on diagnostic problems, covering such aspects as the patient–physician cybernetic system; information collection, storage, analysis, and evaluation; diagnostic algorithms; and the practical application of computer technology in medicine. Actual experiences in employing cybernetic methods for processing medical information are recounted to validate the data. The area of medical electronics is discussed in relation to various automatic devices, biological control problems, and biostimulants. Main trends in the development of bionics are reviewed. An extensive reference bibliography is included. M.G.J.

N67-33302# Naval Material Command, Washington, D. C.
PROCEEDINGS OF THE SYMPOSIUM ON HUMAN PERFORMANCE QUANTIFICATION IN SYSTEMS EFFECTIVENESS
1967 382 p refs Symp. held in Washington, 17–18 Jan. 1967; sponsored by Naval Mater. Command and Natl. Acad. of Eng.
(AD-650791) CFSTI: HC $3.00/MF $0.65

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N67-33303# Navy Dept., Washington, D. C.
NAVY LABORATORY ROLE IN HUMAN PERFORMANCE EFFECTIVENESS
Gerald W. Johnson *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 6 p (See N67-33302 19-05)

Laboratory facilities as well as the tools and methodologies to meet the Navy's requirements for quantitative treatment of the effectiveness of man–machine systems are briefly outlined. Consideration is given to formalized, more standardized participation in fleet activity and to a new emphasis on the use of this participation as an operational test site for the verification of predictions made earlier in system development relating directly to human contribution to systems effectiveness. R.U.

N67-33304# Human Engineering Labs., Aberdeen Proving Ground, Md.
QUANTIFICATION OF HUMAN PERFORMANCE IN U. S. ARMY SYSTEMS RESEARCH AND DEVELOPMENT
John D. Weisz *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 4 p refs (See N67-33302 19-05)

The quantification of human performance in research and development activities is supported by a dynamic U. S. Army program. The program can be divided into four areas. The basic research area is to gain a better understanding of human behavior in military situations. In the personnel research area, the effort is concerned with selection, classification, management, and utilization of personnel. Training, motivation and leadership research is aimed at determining the best methods and techniques for training military personnel as individuals, as teams, and as crew members of man–machine systems. Human factors engineering effort is devoted to performing man–machine compatibility research and application aimed at providing Army personnel with equipment and weapons which they can use and maintain effectively in combat. R.U.

N67-33305# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.
QUANTIFICATION OF HUMAN PERFORMANCE IN SYSTEMS RESEARCH AND DEVELOPMENT: AIR FORCE POSITION STATEMENT
Walter F. Grether *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 7 p refs (See N67-33302 19-05)

The Air Force position on the quantification of human performance in relation to increased effectiveness of newly implemented systems is outlined. The lack of follow-up validation is cited as a deficiency in the information available. R.U.

N67-33306# Naval Material Command, Washington, D. C.
QUANTIFICATION OF HUMAN PERFORMANCE IN NAVY SYSTEMS RESEARCH AND DEVELOPMENT
Heber G. Moore *In its* Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 5 p (See N67-33302 19-05)

United State Navy research in human factors in all phases of system development test and evaluation is briefly detailed. Comparison of approaches highlight human contributions to safety, logistics, maintainability of system, trainability and reliability of personnel in system effectiveness. R.U.

N67-33307# Applied Psychological Services, Wayne, Pa.
PREDICTION OF INDIVIDUAL AND CREW PERFORMANCE BY COMPUTER SIMULATION
Arthur I. Siegel *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 20 p refs (See N67-33302 19-05)

Digital computer simulation, as one type of Monte Carlo simulation, is evaluated to estimate system performance both for individual operators and for crew. This type of simulation involves the development of a model of the system or event to be simulated and a subsequent manipulation of various aspects of the model, through the use of a digital computer. Two computer simulation models described allow simulation of the man–machine interaction before the system is actualized. A prediction of man–machine effectiveness is also provided. Three applications of the model are presented: landing an aircraft on an aircraft carrier, in-flight refueling operation, and simulation of an air intercept. R.U.

N67-33308# Martin Co., Baltimore, Md.
CREW RELIABILITY AND ITS RELATIONSHIP TO SYSTEMS EFFECTIVENESS
Milton A. Grodsky *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 19 p refs (See N67-33302 19-05)
(Contracts NASw-1187; NASw-833)

In an evaluation of crew reliability and systems effectiveness, the problems involved in operator performance are emphasized. It is noted that the development of the hypothesis that reliability and maintainability models in vogue today are valid only when they also consider operator performance factors. The need for quantitative and categorized operator performance data on a variety of tasks is stressed. Guidelines are presented on simulation of a lunar landing, and lifting reentry. Graphical data depict human error as well as etiology and criticality of switching errors. R.U.

N67-33309# Atlantic Fleet, Norfolk, Va. Scientific Advisory Team.
INDIVIDUAL AND CREW PERFORMANCE IN ASW PLATFORMS
James E. Wise *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 17 p refs (See N67-33302 19-05)

Background notes on the establishment and expansion of a military Scientific Advisory Team are presented in connection with a study of individual crew performance in antisubmarine warfare platforms. Human factors study areas include base or experience characteristics, skill identification, on-the-job performance measurements, personal motivation characteritics, job information integration, performance criterion development, fleet-derived selection standards, and fleet-drived training standards. An attempt was made to illustrate the importance of operation or real world setting in determining system effectiveness measures. The central theme depicts performance and readiness as keys to realistic system effectiveness. R.U.

N67-33310# Sandia Corp., Albuquerque, N. Mex.
FIELD CALIBRATED SIMULATION
Alan D. Swain *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 21 p refs (See N67-33302 19-05)

Methodology and applications of field calibrated simulation are presented. Field calibrated simulation is considered a useful combination of the empirical findings conducted under the greater operational realism inherent in field tests, and the greater experimental control and flexibility that is afforded by real-time simulators. Emphasis is on real-time, and for complex man–machine systems, this type of simulation appears to be the only practical way to achieve desired levels of understanding the n-dimensional data space generated by the dependent and independent variables in the system. When data from field calibrated simulation are

reduced to mathematical functional relationships, these relationships become the basis for fast-time simulation necessary for the highest degrees of generalization. Validation of the simulation in man–machine systems aims at evaluating its predictive power. R.U.

N67-33311# Operations Research, Inc., Silver Spring, Md.
HUMAN-INITIATED MALFUNCTIONS
Gabriel Markiohn *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 14 p refs (See N67-33302 19-05)

The apparent significance of human-initiated malfunctions in system effectiveness is considered, and the need is cited for urgent quantification of human performance and reliability research and analysis. The lack of adequate data to identify and describe human error, as well as the reluctance of an individual to identify himself with a failure because of the use of failure reports for disciplinary purposes are considered blocks to researchers. Some basic terms in human reliability analysis are defined, and certain logical limits to the scope of human reliability research are discussed. Problems associated with reporting human errors are highlighted, and some indirect approaches to human reliability analysis are suggested. R.U.

N67-33312# Naval School of Aviation Medicine, Pensacola, Fla.
EXPERIMENTAL RESEARCH IN ANTICIPATORY PHYSICAL THREAT STRESS
Lewis E. Waldelsen, Patrick M. Curran, and Robert J. Wherry, Jr. (Naval Missile Center) *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 23 p refs (See N67-33302 19-05)

Consideration is given to the manner in which the individual perceives his environment, in an investigation of anticipatory physical threat stress (APTS). A model elaborated of the determiners of APTS shows that there are three chief determiners of the amount of psychological stress generated. Major findings of four completed studies are outlined. This system differs from many experiment control systems in that it replaces traditional electro-mechanical activation, timing, and response devices with software or computer programs written for each experiment. This provides feasibility of contingency testing on parameters of performance perception. R.U.

N67-33313# Bunker-Ramo Corp., Canoga Park, Calif.
DEVELOPMENT OF HUMAN RELIABILITY INDICES
David Meister *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 35 p refs (See N67-33302 19-05)

Certain assumptions, characteristics, advantages and disadvantages of the human reliability (HR) method of operator performance prediction are delineated. This technique is compared with alternate approaches to the problem, and special attention is devoted to the gathering and analysis of data required to develop predictive indices. Definitions, conceptual relationships, and implications of the approaches to behavioral reliability are traced, and operator performance is phrased in terms of task accomplishment. Included is an example of a function-flow task diagram and mathematical equation. R.U.

N67-33314# Bell Telephone Labs., Inc., Holmdel, N. J.
THE OPERATOR AND USER IN THE COMMERCIAL TELEPHONE SYSTEM
Jonathan Allen *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 19 p (See N67-33302 19-05)

To improve efficiency of telephone operator time in the customer information area, theory is presented on a semiautomatic (computerized) information system (SIS). Work was undertaken to study present information traffic, find time-consuming items, and suggest human factor improvements. The system was designed to assess operator performance on it by simulation studies. R.U.

N67-33315# Naval Missile Center, Point Mugu, Calif.
OPERATIONAL PERFORMANCE IN AIR-LAUNCHED MISSILE SYSTEMS
Walter E. Leininger *In* Naval Mater. Command Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 9 p (See N67-33302 19-05)

Captive flight investigations of human operator performance in air-launched missile systems are briefly examined. The WALLEYE Missile is used to illustrate the background data presented. The weapon's television image is displayed to the pilot by means of closed-circuit cables to a dual mode radar-video display. In the WALLEYE Missile system the pilot aims the missile and initiates the automatic guidance system, then if the guidance system is locked on the target, the pilot initiates launch. Flight test versus operational performance is discussed briefly, and some human factors to establish engineering design requirements are considered. R.U.

N67-33316# Naval Material Command, Washington, D. C.
SYNTHESES AND SPECIFIC RECOMMENDATIONS
In its Proc. of the Symp. on Human Performance Quantification in Systems Effectiveness 1967 6 p (See N67-33302 19-05)

Specific recommendations presented following the two-day symposium on human performance quantization include the urgent requirement for aggressive, continuous follow-up action. It is specifically recommended that data tanks be established on personnel cost, human error rate related to system performance, and human productivity. Since simulation studies are found to be an essential tool for the analysis and synthesis of complex man–machine systems, it is recommended a human factors simulation group be created. Furthermore, since simulation and laboratory exercises are often used instead of time-consuming, costly operational information, the necessity of testing the validity of *a priori* judgments is essential. There is also an urgent need for evolving systematic procedures for the interchange of information during system development. R.U.

N67-33327# Ohio State Univ. Research Foundation, Columbus.
STUDIES OF PILOT PERFORMANCE IN HELICOPTERS Progress Report, 1 Jun. 1966–31 May 1967
Charles E. Billings, Jack J. Eggspuehler, Ralph J. Gerke, Robert C. Chase, and George E. Briggs Jun. 1967 64 p refs
(Contract DA-49-193-MD-2615)
(RF-1857-3; AD-654046) CFSTI: HC $3.00/MF $0.65

The report describes changes in piloting performance observed during four hours of very low altitude flight in helicopters. In the course of these missions, designed to produce fatigue, pilots tended to allow rotor RPM to vary within wider limits as flight time increased. Control movements of relatively large amplitude increased considerably during the later hours of flight. These changes were evident both during flight in immediate proximity to obstructions and during flight of a less stressful nature. Significant differences among the four pilots studied appeared to be related both to previous helicopter flight experience and to the type of equipment flown prior to the experiment. A validation study was made of the measurement techniques developed in the first phase of the project. Using modified data collection techniques, fixed wing pilots are being studied during 25 hours of flight instruction in helicopters. Both psychological (performance) variables and

physiological functions are being monitored with the hope of observing correlations between them. Improvements in data acquisition and processing techniques are described.
Author (TAB)

N67-33399# Franklin Inst., Philadelphia, Pa. Research Labs.
EMPIRICAL HUMAN-FACTORS INVESTIGATION OF DISPLAY DESIGN Final Report
Clifton E. Mayfield Apr. 1967 71 p refs
(Contract FAA-BRD-423)
(SRDS-67-12; AD-653470) CFSTI: HC $3.00/MF $0.65

The report discusses two experiments in which alphanumeric formats for aircraft flight information are compared. Both experiments utilized a nonintervention dynamic simulation of air traffic which has been called microsimulation. The first experiment, performed with low traffic densities, indicated that altitude and climb-descent information could suitably be placed in tabular format if arranged in order of beacon altitude. In this experiment the target-associated identification always remained in the same position with respect to the target. In the second experiment, a tabular format similar to that of Experiment 1 was compared with a full three-line target-associated tag which was flipped to a new position (relative to the target) whenever overwrites were imminent. The only significant differences were related to the variances of conflictions called by the controller subjects, with the tag format yielding larger variabilities than the tabular format. It is suggested that since this tends to cause unnecessary control actions, the tabular format is at least not inferior to the tag format when traffic densities are high as in this experiment. Author (TAB)

N67-33539# Ionics, Inc., Cambridge, Mass.
AN ELECTROCHEMICAL CARBON DIOXIDE REDUCTION–OXYGEN GENERATION SYSTEM HAVING ONLY LIQUID WASTE PRODUCTS, PHASE I Final Report
Frank B. Leitz and Hans I. Viklund Feb. 1967 37 p refs
(Contract N00014-66-C-0139)
(AD-654146) CFSTI: HC $3.00/MF $0.65

The electrochemical reduction of carbon dioxide has been investigated as a means of simplifying the disposal of carbon dioxide and hydrogen from a submarine atmospheric regeneration unit. Ejection of these materials as gases requires compression and produces a visible exhaust both of which are detection hazards. If these two gas streams could be chemically combined into simple liquid organic compounds, both hazards would be effectively eliminated. Catalytic combination has not proven feasible because of the temperatures and pressures involved. Electrochemical combination of these materials presented a desirable alternative. The investigation which comprises Phase 1 of the overall problem, was undertaken to determine the chemical feasibility of the concept. The major task was selection of appropriate electrodes and operating conditions to carry out the desired electrochemical reactions. Conceptually, the cell consists of an anode at which water is electrolyzed to oxygen, a cathode at which carbon dioxide is reduced, and an electrolyte path between the two. A study of the effect of electrode potential revealed that formic acid could be reduced to methanol at a smooth tin catalyst with 100% current efficiency. The experimental work was sufficiently successful that a working unit, albeit inefficient, could be built with the present technology. However, it will be the purpose of Phase 2 of this program to establish the engineering feasibility of this concept. Author (TAB)

N67-33586* Purdue Univ., Lafayette, Ind. School of Electrical Engineering
SIGNAL DETECTION AND TRANSMISSION IN THE NERVOUS SYSTEM
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 5–7 ref (See N67-33593 19-10)
(Grant PHS-NB-06156)

The physiological preparation of the sciatic nerve of the frog is briefly outlined in a study of signal detection and transmission in the nervous system. A continuous electric current is applied to the excised nerve, which elicits repetitive firing in a number of nerve fibers. In turn, these firings from a number of sites along the nerve are recorded on magnetic tape for later correlation. The delay resulting in maximum signal amplitude establishes the conduction velocity and fiber diameter of the nerve fiber in question. The delay producing maximum amplitude establishes the conduction velocity of the nerve fiber under observation. R.Li.

N67-33623# Navy Experimental Diving Unit, Washington, D. C.
ORIFICE SELECTION IN SEMI-CLOSED CIRCUIT MIXED GAS UNDERWATER BREATHING APPARATUS
John V. Harter 13 Apr. 1967 31 p refs
(RR-1-67; AD-654157) CFSTI: HC $3.00/MF $0.65

Man-in-the-sea operations wherein the gas flow requirements in semi-closed circuit breathing apparatus vary over a wide range due to extension of diving depths in semi-closed circuit breathing apparatus to 600 feet of seawater. A graphical method of orifice selection is presented. Information for graph preparation was obtained through computer operations using standard compressible fluid flow formula for critical flow through an orifice.
Author (TAB)

N67-33708*# California Univ., Berkeley. Space Sciences Lab.
A STUDY OF SIMULATION-AIDED ENGINEERING DESIGN
Ian Mitroff Jun. 1967 344 p refs *Its* Paper No. 66
(Grant NsG-243-62)
(NASA-CR-87163) CSCL 05J

A case study is presented of the behavior of a particular design engineer before and after the introduction of a new design aid, i.e., a computer simulation of the engineer's own design behavior. The formulation and development of a general method for studying engineering design are given, the methodology and general implications of the method are shown, and a particular application of the method is documented. An introductory definition is given of what are considered the real problems confronting the analyst of the engineering design process. This is accomplished by critically evaluating the methods for studying design as proposed by other authors. A discussion is presented of the variables that were not programmed, and it is demonstrated that there is no more basic behavioral variable governing a design than the personality of the client for whom the engineer designs. An extensive explanation is given of the construction and structure of the program model, and basic problems of testing any simulation model are discussed. The most general conclusion is that the extent of the interdependence between the technical and behavioral aspects of design is much greater than has previously been recognized. C.T.C.

N67-33749# Haskins Labs., Inc., New York.
SPEECH RESEARCH Status Report, 1 Jul.–31 Dec. 1966
Franklin S. Cooper Mar. 1967 98 p refs
(Contracts N00014-67-A-0129-0001; V-1005M-1253; Grants DE-01774; HD-01994; FR-5596)
(SR-7/8(1966); AD-653373) CFSTI: HC $3.00/MF $0.65

Extended reports and manuscripts cover the following topics: Hemispheric Specialization and the Perception of Speech. An Electromyographic Study of Articulatory Dynamics in Hearing-Impaired and Normal Speakers. The Identification and Discrimination of Synthetic Nasals. Synthesis by Rule of General American English. Measuring Stop Closure Duration from Intraoral Pressure Records. A Study of Voicing in the Stops Found in the Pre-Linguistic Babblings of Infants. Experiments on the Perception of Mandarin Vowels and Tones. Interim reports on the following topics are also included: The Scaling of Speech Sounds. Perception of Second-Formant Transitions in Non-Speech Patterns.
Author (TAB)

N67-33761# Naval Research Lab., Washington, D. C.
THE PRESENT STATUS OF CHEMICAL RESEARCH IN ATMOSPHERE PURIFICATION AND CONTROL ON NUCLEAR-POWERED SUBMARINES Annual Progress Report
Allen L. Alexander and Victor R. Piatt, ed. 11 Jan. 1967 62 p refs
(NRL-6491; APR-5; AD-648505) CFSTI: HC $3.00/MF $0.65

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7. REVIEW OF THE ELECTROLYTIC PRODUCTION OF OXYGEN IN NUCLEAR-POWERED SUBMARINES J. C. White p 33–39 refs (See N67-33768 19-05)

8. RECENT EXPERIMENTS WITH CHLORELLA P. J. Hannan, R. L. Shuler, and C. Patouillet p 40–48 refs (See N67-33769 19-04)

N67-33763# Naval Research Lab., Washington, D. C.
CHLORINATED HYDROCARBONS IN CLOSED-ENVIRONMENT ATMOSPHERES
R. A. Saunders *In its* The Present Status of Chem. Res. in Atmosphere Purification and Control on Nucl.-Powered Submarines 11 Jan. 1967 p 8–12 refs (See N67-33761 19-05)

Several commercial brands of methyl chloroform used in cements for fastening decorative and insulating covering to bulkheads and pipes during the final fitting of nuclear submarines were analyzed to determine the deleterious effects of samples taken from government stock on space cabin components or other missile parts; and to determine the toxicity of chlorinated hydrocarbons found in submarine and other closed atmospheres. Results indicate that: (1) Some commercial grades of methyl chloroform contain appreciable quantities of other more toxic chlorinated hydrocarbons and the relatively high concentrations of these components may raise the toxicity of the commercial solvent mixtures above that of pure methyl chloroform. (2) Since methyl chloroform is known to decompose under certain conditions on passage through a submarine CO/H_2 catalytic burner, with the formation of additional chlorinated hydrocarbons and corrosive hydrochloric acid, and since some of the chlorinated hydrocarbons so formed might possibly react to yield more toxic substances, the use of chlorinated hydrocarbon solvents should be prohibited in closed environmental atmospheres, where catalytic burners and alkaline materials form part of the air purification system. An analysis of all solvent systems whose use may be necessary in submarines, spacecraft, or other analogous closed spaces, followed by restrictions on the use of those materials which contain or which might produce deleterious substances, is also recommended. S.C.W.

N67-33766# Naval Research Lab., Washington, D. C.
ACTIVATED CARBON—ATMOSPHERE PURIFICATION AND ANALYSIS
J. E. Johnson *In its* The Present Status of Chem. Res. in Atmosphere Purification and Control on Nucl.-Powered Submarines 11 Jan. 1967 p 23–26 refs (See N67-33761 19-05)

The usefulness of activated carbon (charcoal) in nuclear submarines for atmospheric filter applications and for collecting samples of atmospheric contaminants for subsequent analysis is discussed. Included are data on operating guidelines which will promote the every day optimum use of the carbon bed, and a discussion of other more sensitive instrumentation and analytical methods such as: a total hydrocarbon analyzer; a sampling method that involves pumping air from the ship's atmosphere into stainless steel bottles using a small oil free compressor; and a promising analytical approach which is a combination gas chromatograph and rapid scanning mass spectrometer. Future applications of carbon in the analysis of submarine atmospheres are also discussed. S.C.W.

N67-33768# Naval Research Lab., Washington, D. C.
REVIEW OF THE ELECTROLYTIC PRODUCTION OF OXYGEN IN NUCLEAR-POWERED SUBMARINES
J. C. White *In its* The Present Status of Chem. Res. in Atmosphere Purification and Control on Nucl.-Powered Submarines 11 Jan. 1967 p 33–39 refs (See N67-33761 19-05)

In view of the inherent difficulties involved in maintaining high pressure hydrogen and oxygen systems, and because of a number of difficulties which have been encountered in the operation of these high pressure electrolytic oxygen generators, a review of the presently used method and other possible methods for producing oxygen in nuclear powered submarines was undertaken. Presented are results of analyses of these methods and a discussion of areas requiring further improvement. Considered are principles involved in electrolytic generation of oxygen; the present high pressure method; high pressure cells; and ambient pressure cells. It is concluded that the major effort in the improvement of any of the systems cited should be concentrated on the reliability and safety of the components in the system as a whole, and on the reduction of the operating voltage of the cell itself in order to increase efficiency and to reduce heat load. S.C.W.

N67-33843# Hanford Occupational Health Foundation, Richland, Wash. Occupational Hygiene Dept.
RELATIONSHIP OF EFFICIENCY TO PRESSURE DROP OF RESPIRATOR CARTRIDGES WITH INTRODUCED DEFECTS
F. E. Adley and A. G. Rolle Feb. 1967 6 p
(Contract AT(45-1)-1837)
(HOHF-3) CFSTI: HC $3.00/MF $0.65

Results are reported from tests on the full-face respirator masks used for radiological protection at Hanford. Emphasis was placed on the reliability of pressure drop as a test of the efficiency of the filter cartridges. It was concluded that pressure drop is not a valid or safe production screening criterion for respirator filter cartridge integrity and efficiency. NSA

N67-33988# School of Aerospace Medicine, Brooks AFB, Tex.
FIRE PROTECTION FOR OXYGEN ENRICHED ATMOSPHERE APPLICATIONS
B. P. Botteri 23 May 1967 26 p refs Presented at the Fire Hazards and Extinguishment Conf., Brooks AFB, 23 May 1967
(AFAPL-CONF-67-10; AD-653113) CFSTI: HC $3.00/MF $0.65

Effective fire protection is achievable in oxygen enriched atmospheres. Specific requirements toward the realization of this goal include: (1) Elimination of ignition sources; (2) Minimization of combustibles with the complete exclusion of flammable liquids and gases; (3) If combustible materials must be employed, the type, quantity and arrangement in the chambers must be carefully controlled; (4) Fire walls and other containment techniques should be utilized to isolate potential high risk fire zones; (5) A fixed fire extinguishing system should be utilized which incorporates automatic initiation by flame and smoke detectors as well as manual initiation and provides rapid (<2 seconds) and sufficient agent discharge. Author (TAB)

N67-33996*# California Univ., San Diego.
[EXPERIMENTAL TECHNIQUES FOR ANALYZING VISUAL DETECTION PROBABILITY OF OBJECTS IN SPACE] Semiannual Status Report
S. Q. Duntley Jan. 1967 4 p
(Grant NGR-05-009-059)
(NASA-CR-86674) CSCL 06D

Improvements made to increase the potential capability of the maximum sighting range computer program are discussed, including the use of fast Fourier transform algorithms, and the development of an analytic fit to the summative functions. Research was also initiated to access the possibility of modeling the performance of the human visual system in search of a complex background. M.G.J.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-32732# Bausch and Lomb, Inc., Rochester, N. Y. Research and Development Div.
LASER DAMAGE STUDY OF THIN FILMS Quarterly Report, 1 Jan.–1 Apr. 1967
Arthur F. Turner and Stanley J. Refermat 1 Apr. 1967 28 p refs
(Contract Nonr-4717(00); ARPA Order 306)
(QR-4; AD-651988) CFSTI: HC $3.00/MF $0.65

A concentrated effort was made, during the fourth quarterly period, to increase the laser damage threshold, E sub t, of aluminum oxide films. This objective was approached empirically. Selected vacuum deposition parameters were varied and the effect on E sub t was observed. E sub t for one-quarter wavelength and thirty-three quarter wavelengths films were increased by a factor of two over previously reported values. The one-half wavelength threshold was increased by a factor of six over the previous value. The one-quarter wavelength threshold spontaneously fell to half its original value two days after manufacture. Author (TAB)

N67-32769# TRW Systems, Redondo Beach, Calif.
RESEARCH AND APPLICATIONS PROGRAM FOR A SOLID CHEMILUMINESCENT REACTANT Final Report, 16 Mar. 1966–31 Mar. 1967
G. Schlesinger, E. D. Guth, and D. H. Leaman, Jr. 30 Apr. 1967 124 p ref
(Contract DA-04-495-AMC-796(A))
(TRW-05206-6004-R000; AD-653153) CFSTI: HC $3.00/MF $0.65

An investigation was initiated in order to answer critical questions concerning the chemical behavior of the STELLER chemiluminescent material pertinent to its use for night signalling and marking applications. STELLER is used in two-component chemiluminescent systems which emit light when the STELLER is mixed with the oxidizer (see AD-631 458). Performance modification to increase brightness at long durations was approached by controlling the rate of diffusion of the oxidizer ions to the STELLER in the reaction medium. The production of STELLER derivatives which emit light of various colors other than yellow was approached by substituting other acids for hydrochloric acid in the STELLER synthesis. Thermal stability was investigated by exposing STELLER to temperatures in the range from ambient to 167F for periods up to two months. Performance temperature range was determined by measuring the chemiluminescent performance of STELLER at temperatures from -40F to 125F. The effect of reactant purity was determined by synthesizing STELLER with reactants of various purities and measuring the variations in chemiluminescent performance. TAB

N67-32770# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
CRYSTALLOGRAPHIC AND MAGNETIC INVESTIGATION OF THE RARE EARTH–COBALT COMPOUNDS R_2Co_{17} Technical Report, Jan. 1965–Jun. 1966
Werner Ostertag, Karl Strnat, and Gary I. Hoffer Feb. 1967 49 p refs
(AFML-TR-66-420; AD-652837) CFSTI: HC $3.00/MF $0.65

A series of new compounds corresponding to the formula R2Co17, where R represents Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Lu and Y, was prepared. Magnetic measurements showed that about one half of the R2Co17 compounds are ferrimagnetic, while the rest are simple ferromagnets. The saturation moments and Curie temperatures of all the compounds were determined. Interpretation of the structures of the compounds was made on the basis powder X-ray diffraction analysis. TAB

N67-32774# Adelaide Univ. (Australia). Dept. of Physics.
DETERMINATION OF PARTIAL PHOTOIONIZATION CROSS SECTIONS BY PHOTOELECTRON SPECTROSCOPY
A. J. Blake and J. H. Carver [1967] 27 p
(Grant AF-AFOSR-1131-66)
(AD-653214) CFSTI: HC $3.00/MF $0.65

A photoelectron energy spectrometer was used to determine partial photoionization cross sections of molecular oxygen, nitrogen and water vapour for monochromatic incident radiation in the wavelength range 584 - 900A. For each gas, cross sections were determined for transitions to particular ionic states which were identified by measuring the corresponding photoelectron energy. For molecular oxygen, cross sections were determined for transitions to the X(2)Pi-g, (a(4)Pi-u + A(2)Pi-u) b(4) Sigma(-)g and (2)Sigma(-)g states of O2(+) and at incident wavelengths longer than 680A a process of fluorescent autoionization involving quasi-stable states of the neutral oxygen molecule was also observed. Molecular nitrogen cross sections corresponding to transitions to the X(2)Sigma(+)g, A(2)Pi-u and B(2)Sigma(+)u states of N2(+) were determined. For water vapour, cross sections corresponding to transitions to the (2)B1 and (2)A1 states of H2O(+) were observed in addition to processes of dissociative ionization. In all cases the measurements illustrate the competition between various modes of decay which are energetically possible for incident radiation of a given wavelength. Author (TAB)

N67-32775# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.
QUENCHING OF THE RESONANCE RADIATION OF SODIUM BY MOLECULAR NITROGEN
Ernest Bauer Dec. 1966 42 p refs
(Contract DAHC-15-67-C-0011)
(P-304; AD-652581) CFSTI: HC $3.00/MF $0.65

A semiquantitative calculation was made of the cross section for the process Na(3(2)P) + N2(Chi(1)Sigma-G(+); v = 0) to Na(3(2)S) + N2(Chi(1)Sigma-G(+); v = 7,8). To explain the observed cross section, which is of the order of 10 to the -15th power sq cm, it is necessary to postulate an intermediate state which here is ionic in character, involving Na(+) and N2(-); this state is unstable at infinite separation of the atom and molecule, but on account of the Coulomb attraction it becomes stable at separations below approximately 3A. The two transitions into and out of this intermediate state occur by a crossing of potential energy

curves. To obtain significant values for the Landau-Zener transition probability it is necessary to invoke a change of 3-4 vibrational quanta in each transition. The discussion of vibrational overlap integrals in a collision extends Nikitins modification of the Franck-Condon factor. Some discussion of the quenching mechanism for Na(3(2)P) by molecules other than N2 is given in an appendix. TAB

N67-32783# Ceskoslovenska Akademie Ved. Rez. Ustav Jaderneho Vyzkumu.

MECHANISM OF THE HYDROGEN FORMATION IN THE RADIOLYSIS OF LOW TEMPERATURE METHANOLIC GLASSES

J. Teply and I. Janovsky [1967] 31 p refs

(UJV-1739)

Studies showed that the hydrogen yield in the gamma radiolysis of glassy methanol at 77°K depends on many variables. In pure glass (always 5.8 mole % of water) the yield was 4.2 if the trapped electrons were bleached by light and 2.9 if the irradiated glass was rapidly thawed in dark. The presence of electron scavengers suppressed the hydrogen formation in both cases and discolored the glass; after the concentration was sufficient to cause total discoloration the hydrogen yield remained practically constant. The presence of hydrogen atom scavengers suppressed also the hydrogen formation at both photo- and thermal bleaching without causing complete discoloration after irradiation. From the results it has been concluded that the electrons freed from traps by light react with $CH_3OH_2^+$ ions giving hydrogen atoms with some excess of energy which enables them to abstract hydrogen atoms from methanol molecules. The yield of trapped electrons has been determined from the concentration dependencies to be 2.3. Simultaneously with the electrons the hydrogen atoms were independently formed during irradiation with the yield ≈0.5 which were also able to abstract. The remaining hydrogen, i.e., ≈1.4 was unscavengeable by the solutes in the studied concentration range. It accompanied partly the formation of the CH_2OH radical (probably as hot hydrogen atoms with the yield ≈1.1) and partly the formation of carbon monoxide and formaldehyde (most likely as molecular hydrogen with the yield ≈0.3). Author (NSA)

N67-32810# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

ATOMIC GEOMETRY OF THE ALKALI HALIDES Report for Jun.–Oct. 1966

Samuel W. Bradstreet Feb. 1967 71 p refs

(AFML-TR-66-413; AD-652196) CFSTI: HC $3.00/MF $0.65

Current data for the alkali halides (interatomic distances in crystal and vapor, specific gravities, melting temperatures, and elastic moduli) are brought together to show that several mutually consistent ionic and covalent radius values can be developed which, interpolated on the basis of ionicity, will additively describe observed interatomic distances within the required accuracy. Some of the properties of the alkali halides are compared to the properties which would be displayed by a rock-salt structure of ideal octahedral packing. In this way radius ratios can be derived; together with measured interatomic distances these serve to generate unique values for metal and halogen radii for each salt, and these in turn can be extrapolated to obtain unique ionic radii for the halogens and ionic and covalent radii for the alkali metals (for which the latter differ significantly from half the observed interatomic distance in the metals). It is concluded that the principle of additive radii is incapable of universal application since the overlap repulsion term will be influenced by the spatial requirements of packing efficiency. It is suggested that, for the alkali halides at least, correction for this can be provided by an added spacing factor which depends only on the size of the host atom and on the radius ratio. TAB

N67-32859# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.

DILUTE SOLUTION PROPERTIES OF HIGH-MOLECULAR-WEIGHT POLY (ISOBUTYL) METHACRYLATE. VIII: GEL PERMEATION CHROMATOGRAPHY

Susan Doherty and Richard J. Vallee May 1967 41 p refs

(PA-TR-3511; AD-652879) CFSTI: HC $3.00/MF $0.65

Fractions of poly(isobutyl methacrylate) were dissolved in tetrahydrofuran and run at 25°C. Values of –AW and –AN were obtained. The molecular weight of most of the fractions had been obtained previously by light scattering measurements. From the values of –AW and –AN and the 'Q' factor, molecular weights were obtained that were completely erroneous. However, a correlation between –AW and –MW was determined. Without the previously determined information on molecular weight, it would have been impossible to determine this quantity from gel permeation chromatography alone. The molecular weight distribution was studied only briefly. Author (TAB)

N67-32869# Little (Arthur D.), Inc., Cambridge, Mass.

GASEOUS TERNARY COMPOUNDS OF THE ALKALI METALS

Alfred Buechler and Joan Berkowitz-Mattuck [1967] 122 p refs

(Contract DA-31-124-ARO(D)-315)

(AROD-006-24-c; AD-653163) CFSTI: HC $3.00/MF $0.65

An extensive summary is given of the existing information on gaseous ternary salts of the alkali metals. Three groups of compounds are considered: (1) salts of monobasic acids or pseudohalides (e.g., hydroxides, metaborates, nitrates, perrhenates); (2) salts of dibasic acids (e.g., carbonates, sulfates); (3) mixed halides (e.g., LiBeF3, NaAlF4, KFeCl3). The identification of vapor species, structural data, and thermodynamics are discussed for each type of compound. Particular experimental problems and methods of data analysis are considered as they arise with reference to individual compounds. TAB

N67-32880# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POLYMERIZATION AND COPOLYMERIZATION OF TETRACYANOETHYLENE UNDER THE EFFECT OF POLYMERS WITH A CONJUGATED SYSTEM [O POLIMERIZATSII I SOPOLIMERIZATSII TETRATSIANETILENA POD DEYSTVIYEM POLIMEROV S SISTEMOY SOPRY-AZHENIYA]

A. A. Berlin and N. G. Matveyeva 23 Jan. 1967 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 167, no. 1, 1966 p 91–94

(FTD-HT-66-729; TT-67-62010; AD-652483) CFSTI: HC $3.00/MF $0.65

The feasibility was studied of using paramagnetic conjugated polymers as catalysts in the quasi-radical polymerization and copolymerization of low reactivity monomers such as tetracyanoethylene (I), anthracene, naphthacene and pentacene. I was polymerized alone or copolymerized with anthracene, naphthacene, or pentacene. Soluble fractions of polyphenylene or polyanthryl were used as the catalyst in various concentrations so as to vary the unpaired spin concentration. It was found that the polymer or copolymer yield increased with spin concentration. In the case of the copolymerization of I with anthracene, the highest yield was obtained at a I/anthracene ratio of 4/1. The electrical conductivity of the copolymers was 5-6 orders of magnitude as high as that of anthracene, and had an activation energy of 8-11 kcal/mol. Naphthacene, pentacene, and polyphenylene also copolymerized with I. A mechanism is proposed for the catalysis, which involves charge-transfer complex formation. TAB

N67-32898# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
STUDIES ON THE HYDROLYSIS OF METAL IONS 57. THE HYDROLYSIS OF CERIUM(IV) IN 3 M(Na)NO_3 MEDIUM
Pier Roberto Danesi (Calif. Univ., San Francisco) 1966 34 p refs
(RT/CHI/66/39)

The hydrolysis of Ce(IV) ions was studied at 25°C in the medium, 3M $(Na)NO_3$-$[H^+]$ = h was measured with a glass electrode and $[Ce^{4+}]$ = b with a gold redox electrode. The $[Ce(IV)]_{tot}$ was varied from 10 to 100 mmole. There was evidence of slow reactions. The data were treated with the computer program LETAGROP with independent adjustment of analytical errors. By writing the reactions as: $q\,Ce^{4+} + p\,H_2O = Ce_q(OH)_p^{(4q-p)+} + pH^+$ and the equilibrium constants as $\beta_{p,q}$, the best combination of complexes and equilibrium constants was found to be: $Ce_2(OH)_3^{+}$, $\beta_{3,2} = (5.1 \pm 0.3)10^{-2}$, $Ce_2(OH)_4^{+}$, $\beta_{4,2} = (2.3 \pm 0.3)10^{-3}$, $Ce_6(OH)_{12}^{+}$, $\beta_{12,6} = (1.36 \pm 0.06)10^{-2}$. Author (NSA)

N67-32902# Manlabs, Inc., Cambridge, Mass.
THERMODYNAMIC STUDY OF SYNTHESIS OF NEW COMPOUND PHASES UNDER HIGH PRESSURE
Edward V. Clougherty and Larry Kaufman Feb. 1967 53 p refs
(Contract AF 19(628)-5745)
(SR-1; AFCRL-67-0290; AD-652828) CFSTI: HC $3.00/MF $0.65

A phenomenological analysis and correlation of available volumetric and entropy data was performed for the III-V compounds. The results of these procedures were used to predict the volumetric properties of the known high pressure forms of BN and the unknown forms of BSb. In addition, values for compound entropy and the entropy of formation were predicted for the above compounds, BN and BSb, and for several known III-V compounds for which such data are presently lacking. The value for the P-T coefficient, was also calculated (from the predicted quantities) for the BN transformations and for the synthesis of BSb from the elements. An experimental program was carried out to attempt to synthesize a new compound BSb. The results obtained suggest that the B-Sb system at 50 kilobars is characterized by a miscibility gap in the liquid phase. High pressure experiments were also carried out for AlN; the results obtained show that solid aluminum nitride and solid boron nitride react by a diffusion process which produces marked changes in the microhardness and morphology of the boron nitride. Author (TAB)

N67-32910# Western New York Nuclear Research Center, Inc., Buffalo.
DEVELOPMENT OF A RADIOACTIVE PEBBLE BED CHEMICAL REACTOR SYSTEM, PHASE I Final Report
C. H. Collins, H. T. Cullinan, C. C. Thomas, Jr., and S. Weller 15 Sep. 1966 84 p refs
(Contract AT(30-1)-3718)
(NYO-3718-1)

Background information was developed on potential source requirements and on the chemical reaction under consideration (the side chain chlorination of toluene to produce benzotrichloride); equipment was designed appropriate to a bench-scale investigation; and an economic evaluation was made of the proposed reaction. The chlorination of toluene can occur either by side chain substitution or by ring addition. Both the radiation-initiated and the photoinitiated chlorination reactions yield the same products under the same reaction conditions. Ring addition predominates at temperatures below 20°C while side chain substitution to produce benzotrichloride occurs essentially exclusively at temperatures greater than 80°C. The efficiency of energy utilization in the radiation chlorination of benzene has an inverse relationship to the LET of the incident radiation. The extent of the radiolysis of pure benzene (and toluene), an undesirable side effect, is directly related to the LET of the radiation. Beta sources, which would minimize adverse LET effects, are potentially available in several forms and configurations. Comparisons of the radiation chlorination of benzene with the photochlorination of benzene indicated that radioinduced chlorination is more efficient in energy utilization by an estimated factor of 8.5. Calculations of design parameters for a fluidized bed chemical reactor showed that particles of 250 μ or greater could be used in a small, bench-scale reactor, while particles of greater than 500 μ are indicated for best reactor performance in a commercial scale reactor. Estimates of the cost of producing benzotrichloride from toluene using a pebble bed radiation source are dependent on the G value for this reaction. Assumed G values ranging from 10^4 to 10^5 indicated that production costs for benzotrichloride are below or within the same range as comparable figures available from industry for the commercial photochemical process. NSA

N67-32950# Dayton Univ., Ohio.
INFORMAL SYMPOSIUM ON REVERSIBLE PHOTOCHEMICAL PROCESSES
3 May 1967 47 p refs Symp. held 1–3 May 1967
(AD-653030)

The document is comprised of abstracts of the 34 papers presented at the symposia. TAB

N67-33030# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SEPARATION METHOD FOR RARE-EARTHS USING HIGH VOLTAGE ELECTROPHORESIS ON PAPER STRIP [METHODE DE SEPARATION DES TERRES RARE PAR ELECTROPHORESE A HAUTE TENSION SUR PAPIER-SUPPORT]
Jeanine Clarence Aug. 1966 97 p refs In FRENCH; ENGLISH summary
(CEA-R-2877) CFSTI: HC $3.00/MF $0.65

The equipment includes an electrophoresis set running at 3,000 V and 20 mA. Two cooling plates are used as heat exchanger, and a pneumatic pressure device to insure an uniform pressure on the paper strip laid flat. The mobilities and the separations of the rare earths in lactic, and α hydroxyisobutyric acid solutions are investigated on cellulose acetate strip. Better results are obtained with α hydroxyisobutyric acid. The method is rapid and allows a fine fractionation of rare earth elements within less than an hour. A complete separation of a Ce–Pr–Nd–Pm–Eu mixture, and a Y–Tb mixture is obtained. Author

N67-33031# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
COMPARISON OF SOME METHODS FOR ANALYZING THE OPTICAL PROPERTIES OF MOLECULAR AGGREGATES [COMPARISON DE QUELQUES METHODES D'ANALYSE DES PROPRIETES OPTIQUES DES AGREGATS MOLECULAIRES]
Jean Thiery Dec. 1965 15 p refs In FRENCH; ENGLISH Summary
(CEA-R-2878) CFSTI: HC $3.00/MF $0.65

This report compares the application both of the exciton theory and the polarizability theory to the study of the optical properties of dimers made up of two identical molecules having only one excited level when separate, and which are held together in the dimer only by Van der Waals forces to the exclusion of any covalent bonding. Using this theoretical basis, the author gives an interpretation of the changes in the spectrum of aqueous NN' diethylcyanine solutions as a function of concentration, and stresses the present lack of experimental data necessary for understanding of the mechanism of the hypochromism of nucleic acids. Author

N67-33043# California Univ., Livermore. Lawrence Radiation Lab.

DETERMINATION OF TRACE CHLORINE IN FLUOROELASTOMERS General Chemistry Technical Note

Robert Lim 4 Apr. 1967 6 p refs

(Contract W-7405-ENG-48)

(UCID-15100; TN-237) CFSTI: HC $3.00/MF $0.65

A method for determining trace chlorine in fluoroelastomers is presented. The fluoroelastomer, with paraffin added as fuel, was burned in a platinum-lined oxygen bomb containing sodium hydroxide absorbing solution. This solution was then titrated with mercuric nitrate, with s-diphenylcarbazone used as the indicator.

Author (NSA)

N67-33057# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SYNTHESIS OF NEW ANILS OF HETEROCYCLIC AND AROMATIC SERIES

Yu. A. Zhadan, and I. D. Sedekov 28 Feb. 1967 11 p refs

Transl. into ENGLISH from Izv. Vysshykh Uchebn. Zavedenii, Khim. Utekhnol. (Ivanovo), v. 8, no. 6, 1965 p 954–958

(FTD-HT-67-190; AD-653538) CFSTI: HC $3.00/MF $0.65

Thirty-five anils and O-hydroxyanils of aromatic and heterocyclic aldehydes that have not been described in literature were synthesized. The characteristics and a description of them are given in a table.

TAB

N67-33080# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CORROSION OF COPPER BY CHLORINE TRIFLUORIDE [LA CORROSION DU CUIVRE PAR LE TRIFLUORURE DE CHLORE]

Louis Vincent (Ph.D. Thesis—Paris Univ., 1965) 1966 57 p refs

In FRENCH; ENGLISH summary

(CEA-R-2790)

The chlorine trifluoride was highly purified before use. The tests were carried out under different pressure and temperature conditions on copper samples of various purities, in particular a 99.999% copper in the form of mono-crystals. The kinetics showed reactions of the same order of magnitude as those obtained with elemetary fluorine. At atmospheric pressure there occurs formation of cupric fluoride and cuprous chloride, showing that it is not possible to consider ClF_3 simply as a fluorinating agent. At low pressures an unknown product was characterized. There are strong grounds for believing that it is unstable cuprous fluoride. A germination phenomenon was shown to exist indicating an analogy between the initial phases of fluorination and those of oxidation. Important effects resulting from the dissociation of the copper fluorides and the solubility of chlorine in this metal were demonstrated. Tests showed the considerable influence of the purity of the gas phase and of the nature of the reaction vessel walls on the rates of corrosion.

Author

N67-33099# Iowa State Univ. of Science and Technology, Ames.

DIFFERENTIAL CAPACITY OF THE ELECTRICAL DOUBLE LAYER AT THE SILVER IODIDE-AQUEOUS SOLUTION INTERFACE

David Morton Barshatsky (Ph.D. Thesis) Feb. 1967 106 p refs

(Contract W-7405-ENG-82)

(IS-T-145) CFSTI: HC $3.00/MF $0.65

An impedance bridge was used to determine the equivalent series capacitance C_Y and resistance R_Y for the silver iodide aqueous solution system. An AgI electrode in contact with an aqueous potassium nitrate solution containing a very dilute concentration of Ag^+ and I^- ions served as the system. A cell potential range of about 420 millivolts was used at KNO_3 concentrations of 0.1, 0.01, and 0.001 N. The C_Y and R_Y values at a given potential and electrolyte concentration was determined in a frequency range from 256 to 9,168 cps. Several electrodes of varying AgI thickness were studied to check the consistency of the results. An electrical analog circuit was proposed for the interface which was consistent with known properties of this interface and which adequately represented the dependence of C_Y and R_Y on frequency and potential over the ranges of frequency and potential studied. It was shown that the frequency dependencies of both C_Y and R_Y are due to distributed capacitances in the pores of AgI. This effect can be described by tapered RC transmission lines connected in parallel. The equivalent capacitance and resistance of one line represents the impedance in one pore. The equivalent capacitance C_p and resistance R_p of the parallel transmission lines is in parallel with the differential capacitance C_D of the double layer associated with the flat portion of the AgI. The resulting impedance is in series with both the series equivalent capacitance C' and resistance R' of solid AgI and the solution resistance. Capacitance C' arises from space charges of defects in the AgI. By setting the value of the AgI double layer capacity equal to that for the mercury–aqueous sodium fluoride solution interface at the zero point of charge at 0.001 N solution the areas of the flat portion of the AgI electrode is determined, and hence the AgI double layer capacity at any potential and electrolyte concentration. The double layer capacity values agree very well with those of Agar around the zero point of charge at various electrolyte concentrations. Whereas Agar's values decrease slightly at high negative potentials, increased values in this potential range were observed.

Author (NSA)

N67-33110# New York. Univ., N. Y. Dept. of Chemistry.

ORIENTATION AND REACTIVITY IN FREE RADICAL AROMATIC SUBSTITUTION Final Report

Robert T. Morrison Apr. 1967 8 p refs

(Grant AF-AFOSR-619-64)

(AFOSR-67-1059; AD-652250) CFSTI: HC $3.00/MF $0.65

A summary is given of work involving the study of orientation and reactivity in free radical aromatic substitution, with particular emphasis on polar factors. The principle approach was to study the attack by substituted phenyl radicals (chiefly from peroxide decomposition) on aromatic compounds. In addition, investigations were undertaken to (1) redetermine orientation and reactivity in simple phenylation; (2) test the validity of previously determined rate factors for the reaction Ar- + ArH yields ArArH-; and (3) study ester formation in peroxide ((ArCOO)2) decompositions.

TAB

N67-33118# Ohio State Univ. Research Foundation, Columbus.

THE INFRARED ABSORPTION BANDS OF OZONE

David J. McCaa and John H. Shaw Feb. 1967 105 p refs

(Contract AF 19(628)-3808)

(AFCRL-67-0237; SR-2; AD-653195) CFSTI: HC $3.00/MF $0.65

Fourteen bands of ozone between 500 and 3300 per cm have been identified and values of the vibrational anharmonic constants determined. The integrated band absorptances of many of these bands have been measured from spectra of a 32 m path of ozone-oxygen mixtures containing up to 30 atm cm O3 near 25C. The dependences of the band absorptances on O3 concentration and total pressure are described and the strengths of nine of the bands are given. It is shown that the statistical band model describes the behavior of the bands reasonably well for the ranges of experimental variables used.

Author (TAB)

N67-33148# Monsanto Research Corp., Dayton, Ohio.

SOLVENT EXTRACTION STUDY OF METAL FLUOROACETYLACETONATES Scientific Interim Report, 10 Sep. 1965–9 Sep. 1966

William G. Scribner and Mary F. Borchers Wright-Patterson AFB, Ohio. ARL. Sep 1966 113 p
(Contract AF 33(615)-1093)
(ARL-66-0192; AD-646607) CFSTI: HC $3.00/MF $0.65

Results of a program to study the solvent extraction properties of trifluoroacetylacetone and hexafluoroacetylacetone are described. Log distribution-pH curves are presented for the extraction of iron (III), copper, beryllium, zinc, and cobalt with benzene-hexafluoroacetylacetone; for the extraction of beryllium with benzene, chloroform, and toluene containing trifluoroacetylacetone; for the extraction of copper, cobalt, and beryllium with butanol-trifluoroacetylacetone; and for the extraction chromium (III) with toluenetrifluoroacetylacetone. A survey of various solvent systems for the extraction of calcium with trifluoroacetylacetone and hexafluoroacetylacetone is also presented. For most systems, equilibration time studies and anion interference studies are described to aid in the establishment of analytically useful procedures. Acute toxicity studies on trifluoroacetylacetone and 2,2,6,6-tetramethylheptane-3,5-dione are described and permit the assignment of the rating 'toxic' to trifluoroacetylacetone and 'not toxic' to the other beta-diketone.

Author (TAB)

N67-33151# Pennsalt Chemicals Corp., King of Prussia, Pa. Research and Development Dept.
INORGANIC COORDINATION POLYMERS. IX: TITANIUM (IV) PHOSPHINATE POLYMERS
Gerd H. Dahl and B. Peter Block May 1967 22 p refs Submitted for publication
(Contract Nonr-2687(00))
(TR-53; AD-651975) CFSTI: HC $3.00/MF $0.65

The following titanium(IV) phosphinates were prepared, mainly by metathesis: (i) Ti(OR)2(OPRRO)2 with R, R, and R, respectively, CH3, CH3, or C4H9; CH3, C6H5, and C2H5; or C6H5, C6H5, and C2H5 or i-C3H7; (ii) TiCl2(OP(C6H5)2O)2; (iii) TiO(OPRRO)2 with R and R both CH3, both C6H5, or one CH3 and one C6H5; (iv) Ti(OP(C6H5)2O)4; and (v) Ti(BB)(OPRRO)2 with BB, R, and R, respectively, ortho-OPhO, CH3 or C6H5, and C6H5; ortho-OPhCO2, CH3, and C6H5; (CH3)2C(O-)CH2CH(O-)CH3, C6H5, and C6H5; OC3H6O, CH3 or C6H5, and C6H5 P(O)2CH2P(O)2C6H5, CH3, and C6H5. TiCl2(OP(C6H5)2O)2 was prepared by the thermal decomposition of TiCl4(OP(C6H5)2OC2H5)2. Molecular weight data show that all the titanium(IV) phosphinates made are at least trimers, and that some have degrees of polymerization exceeding 20. Their infrared spectra are consistent with phosphinate bridging, and it is probable that double phosphinate bridges are present in most of the polymers. Infrared data also are in accord with Ti(O) analysis shows that weight loss starts at temperatures as high as 450 deg in nitrogen for some of the polymers prepared.

Author (TAB)

N67-33153# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Group.
ICOSAHEDRAL CARBORANES. XI: GERMANIUM AND TIN DERIVATIVES OF O-CARBORANE, M-CARBORANE, AND P-CARBORANE AND THEIR POLYMERS
Hansjuergen Schroeder, Stelvio Papetti, Roy P. Alexander, John F. Sieckhaus, and Theodore L. Heying May 1967 18 p refs Presented at the 3d Intern. Symp. of Metalorganic Chem., Munich, Sep. 1967
(Contract Nonr-3395(00))
(TR-37; AD-652379) CFSTI: HC $3.00/MF $0.65

The dilithio salts of o-, m-, and p-carborane were reacted with selected chloro derivatives of germanium and tin. In the germanium series, disubstituted o-carborane derivatives were formed as in the similar silicon chemistry, but the germanium m- and p-carborane products obtained were mixtures of disubstituted monomers and related polymers. In analogous reactions of the dilithio salts with various substituted dichloro tin derivatives, it was found that the substituents have a marked influence on the type of derivative formed. Where the substituents were alkyl groups, the o-carborane products contained distannocyclohexane rings while the m- and p-carborane products were exclusively polymers. In syntheses involving (C6H5)2Sn.Cl2, a variety of products was obtained including mono- and di-substituted compounds as well as linear polymers of considerable molecular weight.

Author (TAB)

N67-33160# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
CORROSION IN THE PRESENCE OF A COMPLEXING AGENT APPLICATION TO THE CONTINUOUS DETERMINATION OF HYDROFLUORIC ACID IN THE ATMOSPHERE [CORROSION EN PRESENCE DE COMPLEXANT APPLICATION A LA DETERMINATION EN CONTINU DE L'ACIDE FLUORHYDRIQUE DAUS L'ATMOSPHERE]
Yves Chapron (M.S. Thesis) Oct. 1966 108 p refs In FRENCH; ENGLISH summary
(CEA-R-3031) CFSTI: HC $3.00/MF $0.65

After a presentation of the thermodynamics and kinetics involved during corrosion in the presence of a complexing agent, the first part of this report deals with the electrochemical properties of an aluminium electrode in the presence of fluoride solutions. Various physical and chemical parameters have been studied together with their influence on the aforementioned properties. From this first part are deduced the medium and the various parameters which lead to the maximum efficiency for the detection of fluorides by amperometry. The second part is an application of the results of the above work, which has made it possible to develop a cell having an original design. Its performances are described. They show that the cell has a greater sensitivity and a shorter response time than existing equipment.

Author

N67-33198* Catalyst Research Corp., Baltimore, Md.
TEST EVALUATION OF FUEL CELL CATALYSTS, 15 FEBRUARY–15 MAY 1967
H. J. Goldsmith, J. R. Moser, and T. Webb 15 May 1967 57 p refs
(Contract NASw-1577)
(NASA-CR-87142; Q-1) CSCL 07D

Nineteen iron compounds were tested at 25°C for anodic activity toward ammonia in 30% KOH and saturated K_2CO_3 and carbon monoxide in saturated K_2CO_3, 85% H_3PO_4, and 2N H_2SO_4. Corrosion potentials were run to determine usable electrolyte and catalyst combinations. Surface areas were measured by double layer capacitance. Current versus voltage measurements at 25°C showed that none of the catalysts were more than 2% as active as platinum black.

Author

N67-33200# California Univ., Berkeley. Lawrence Radiation Lab.
INDEX TO NUCLEAR CHEMISTRY DIVISION ANNUAL REPORT, 1966
28 Mar. 1967 42 p
(Contract W-7405-ENG-48)
(UCRL-17299) CFSTI: HC $3.00/MF $0.65

A permuted index is presented of the key words and numbers contained in the titles of the report papers. Authors' surnames are also indexed.

Author

N67-33203# Michigan State Univ., East Lansing. Dept. of Chemistry.
ELECTRON SPIN RESONANCE STUDIES OF RADICALS IN IRRADIATED CRYSTALS

Max T. Rogers and L. D. Kispert [1967] 7 p refs Presented at the Intern. Conf. on Spetroscopy, Bombay, 9–18 Jan. 1967
(Contract AT(11-1)-1385)
(COO-1385-20; CONF-670114-1) CFSTI: HC$3.00/MF$0.65

Free radicals induced in organic compounds by electron irradiation at 77° and 300°K were studied by ESR spectra. Sodium acetate trihydrate yielded the methyl radical at 77°K but only the CH_2COO-radical at 300°K. Trifluoroacetamide gave rise to the trifluoromethyl radical at 77°K and to the CF_2CONH_2 radical at 300°K. Irradiated crystals of $CClF_2COONa \cdot 2H_2O$ gave only the radical CF_2COO^-, but these were in several different types of environment in the crystal lattice. The results indicate that aliphatic radicals of the type CXYZ are planar if one of the substituents is hydrogen and nonplanar if two or three of the substituents are fluorine. NSA

N67-33215# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A STUDY OF CHEMICAL SHIFT IN THE NUCLEAR MAGNETIC RESONANCE OF FLUORIDE IONS IN CRYSTALS AND IN SOLUTIONS

F. N. Skripof and I-tseu Wang *In its* J. of Phys., Vol. 20, No. 1 31 May 1966 p 1–28 (See N67-33214 19-17)

This paper gives a brief description of a radiofrequency spectroscope with medium resolving power for the observation of signals of nuclear magnetic resonance and a method of measuring chemical shift in solids. A study was made of the chemical shift (δ) in the nuclear magnetic resonance of fluorides of the elements of Group I and II of the periodic table and of F^{19} in crystals. It was found that with the exception of LiF, δ diminishes with the increase in the atomic number of the metal. Results were interpreted on the basis of the theory of partial covalency of Yoshida and Moriya, and also by the theory of overlapping electron shells of Kondo and Yamada. The overlap integral among neighboring ions was calculated for all alkali fluorides. Using the formula of Kondo and Yamashita, a value of the magnetic screening constant was obtained which agreed well with experimental value. Based on this agreement, the absolute value (σ) of the magnetic screening constant of fluorine was estimated. The dependence of δ on concentration was measured in water solutions of NH_4F. δ dropped rapidly with the increase in concentration. Extrapolating from the curve of the dependence of δ on concentration to the point corresponding to the concentration in solids, a δ value was obtained which agreed very well with that measured directly in the experiments. Chemical shifts of other alkali fluorides in water solution showed analogous behavior which indicates that the effect of the interaction of the ions on the electronic structure of the ion is the same in solutions as in crystals. Studying the water solutions of the salts of acids of fluorine, the δ values were determined for HF and HF_2 to be $(60.0 \pm 0.5)10^{-6}$ and $(58.1 \pm 0.3)10^{-6}$. They appear to be equal. Author

N67-33223# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

THE VOLATILE RARE EARTH CHELATES OF 1, 1, 1, 2, 2, 3, 3-HEPTA FLUORO-7, 7-DIMETHYL-4, 6-OCTANEDIONE Interim Report, May 1965–Feb. 1967

Charles S. Springer, Jr. (Ph.D. Thesis—Ohio State Univ), Robert E. Sievers, and Devon W. Meek May 1967 114 p refs
(ARL-67-0094; AD-653183) CFSTI: HC$3.00/MF$0.65

Inner complexes of fourteen trivalent rare earth ions with the bidentate ligand 1, 1, 1, 2, 2, 3, 3-heptafluoro-7, 7-dimethyl-4, 6-octanedionate, fod, were synthesized and studied. The products isolated have the formula, $M(fod)3.H_2O$, but are easily dehydrated in vacuo over P4O10 or by heating in an anhydrous atmosphere. The beta-diketonate ligand was synthesized via a Claisen condensation. The fod complexes of Sc(III), Cr(III), and Al(III) were also prepared and all found to have the formula, M(fod)3. The anhydrous rare earth complexes and the Sc, Cr, and Al compounds are six-coordinate. The chromium and aluminum complexes are octahedral but the structures of the rare earth and scandium complexes are unknown. The coordination numbers and structures of the hydrated rare earth complexes are also unknown. The anhydrous rare earth complexes are the most volatile rare earth compounds known, and they were studied by gas chromatography and thermogravimetric analysis. The volatilities of these compounds vary in inverse proportion with the ionic radius of the metal ion. Author (TAB)

N67-33236# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.

GEL-ADDITION PROCESS CHEMICAL STUDIES Quarterly Progress Report, Oct.–Dec. 1966

E. H. Dewell, comp. May 1967 40 p refs
(Contract AT(30-1)-3714)
(BAW-3714-2; QPR-2) CFSTI: HC$3.00/MF$0.65

Development of the gel-addition process for preparing plutonia–urania mixed oxide fuels has been extended from study of the interaction of UO_2 gels and plutonium solutions to include development of equipment for firing to oxides and methods for examination of oxide microstructure. Improvements made in the preparation of UO_2 sols from uranyl nitrate include monitoring the reduction step ($U^{VI} \rightarrow U^{IV}$) to prevent nitrate co-reduction, and dispersal of the uranous hydroxide filter cake ultrasonically to a sol. Author (NSA)

N67-33236# Boston Univ., Mass. Dept. of Physics.

MOSSBAUER SPECTRA AND EFFECTIVE FIELD PARAMETERS IN IRON COMPOUNDS

Gilbert R. Hoy and Subhas Chandra Mar. 1967 215 p ref
(Grant DA-ARO(D)-31-124-G808)
(AROD-6388-5-P; AD-654044) CFSTI: HC$3.00/MF$0.65

Mossbauer spectra were computed for the situation in which both static quadrupole and hyperfine interactions are present. The explicit calculations are restricted to the case when either the source or absorber is a 'single line' and the nuclear levels are the same as in the 57Fe 14.4 KeV transition. Furthermore, the calculations apply only to powder samples. Cases are included in which the asymmetry parameter of the electric field gradient tensor (EFG) is non-zero and various possible directions of the internal effective magnetic field with respect to the EFG principal axes are allowed. The purpose of the report is to provide the means by which experimentalists, doing Mossbauer spectroscopy in ferrous compounds below their transition temperatures, can estimate the effective field parameters in their specimen. To that end a graphical representation is included as well as the explicit values for peak positions and intensities assuming various values of the effective field parameters. Author (TAB)

N67-33252# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.

A RAPID COLORIMETRIC METHOD FOR FIELD DETERMINATION OF NITROGEN DIOXIDE IN FUMES FROM EXPLOSIVES

Edward J. Murphy Jul. 1967 26 p refs
(BM-RI-6981)

A fast, reliable modification of the Griess–Ilosvay procedure suitable for field analysis for NO_2 in the fumes from explosives was developed. Known concentrations of NO_2-air mixtures were analyzed for the nitrous acid or nitrite formed in the reaction with three Griess–Ilosvay-type reagents by diazotizing and coupling. Comparison was made of the Rider–Mellon, Saltzman, and Patty–Petty procedures; the three procedures are in agreement if sufficient time of contact between NO_2 and the reagents is allowed. In experiments to obtain an accurate factor for converting NO_2 to nitrite, overnight contact was allowed in order to be sure

conversion was complete. The factor was found to be 75 percent with a standard deviation of ±3.2. Low and erratic results were found using either the Saltzman or Patty–Petty reagents as absorbing liquids unless several hours' contact was allowed. If dilute NaOH solution was used as the absorbing liquid instead of a Griess–Ilosvay-type reagent, 92 percent of the overnight conversion factor was found after a 3-minute shaking time and a 10-minute standby time. The Saltzman reagent was preferable for fieldwork with the dilute NaOH solution as the absorbent because of its easy application, rapid reaction, and intense color even at low NO_2 concentrations. Author

N67-33259# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

CONTRIBUTION TO THE STUDY OF THE STRUCTURE AND REACTIVITY OF KETONES USING DEUTERIUM SUBSTITUTION OF THE α-KETONE HYDROGENS [CONTRIBUTION A L'ETUDE DE LA STRUCTURE ET DE LA REACTIVITE DES CETONES PAR UTILISATION DE LA SUBSTITUTION DEUTERIEE DES HYDROGENES α-CETONIQUES]

Gérard Frejaville (Ph.D. Thesis—Paris Univ., Orsay, France) 1966 67 p refs In FRENCH; ENGLISH summary
(CEA-R-2955) CFSTI: HC $3.00/MF $0.65

This work is a contribution to conformational analysis based on infra-red signals associated with the C-D vibration in mono-deuterated compounds. Various dosage and synthetic methods used in this work are described. The infra-red spectra in the 2100–2200 cm^{-1} region for mono-deuterated ketones are interpreted on the basis of a simple model. This model is then studied in detail, and also critically and precisely, in the case of the monodeuterated acetone molecule. The mechanism of the Faworskii reaction and the reactivity of all the α ketonic hydrogens of 2 chloro cyclohexanone are classified. A countercurrent exchange method for obtaining a great variety of solvents and deuterated pure raw materials under advantageous conditions, is described. Author

N67-33281 Ministry of Technology, London (England). Technical Information and Library Services.

THE APPLICATION OF DIFFERENTIAL THERMAL ANALYSIS AND THERMOGRAVIMETRY IN THE EXAMINATION OF EXPLOSIVES [UEBER ANWENDUNGSMOEGLICHKEITEN DER DIFFERENTIAL THERMOANALYSE UND DER THERMOGRAVIMETRIE BEI DER UNTERSUCHUNG VON EXPLOSIVSTOFFEN]

G. Krien May 1967 18 p refs Transl. into ENGLISH from Explosivestoffe (Germany), v. 13, no. 8, 1965 p 205–220
(TIL/T-5719)

Thermographs are obtained in which weight and enthalpy are shown in terms of temperature. It provides an extensive picture to be obtained of the physical and chemical processes in single or mixed explosives. The limitations of the method are examined by examples and its value in safe testing of developments in explosives indicated. Author

N67-33289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

IONIC-MOLECULAR REACTIONS OF HYDROGEN WITH NOBLE GASES

M. V. Tikhomirov, G. Ye. Spezhakova, and N. N. Tunitskiy 23 Mar. 1967 16 p refs Transl. into ENGLISH of the book "Ionno-Molekulyarnyye Reaktsii Vodoroda s Blagorodnymi Gazami" Moscow, Nauchno-Issled. Fiz.-Khim Inst., 1965 p 1–11
(FTD-MT-65-547; AD-653510) CFSTI: HC $3.00/MF $0.65

The dependence of the yield of HeH(+) and HeD(+) ions on the energy of ionizing electrons in ionic-molecular reactions is investigated. It is shown that the relative yield of HeH(+) ions decreases in the electron energy field from 25 to 17 ev, and the ratio HeH(+)/HeD(+) is constant and approximately equal to 0.8 when the energy changes from 70 to 25 ev. The dependence of a cross section of a reaction on the vibrational state of an H2(+) ion is investigated in accordance with O. B. Firsova ionic-molecular reaction theory. It is shown that an intermediate complex of this reaction decomposes into initial products with great probability, which decreases the HeH(+) yield. The experimental dependence of the HeH(+) yield on electron energy agrees with the theory. Author (TAB)

N67-33320# Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.

THERMODYNAMIC PROPERTIES OF ORGANIC DERIVATIVES OF THE LIGHTER ELEMENTS Annual Technical Summary Report, 1 Mar. 1966–1 Mar. 1967

Donald R. Douslin, William D. Good, Herman L. Finke, Samuel S. Todd, George B. Guthrie et al 1 Mar. 1967 22 p refs
(Contract OAR-ISSA-66-6)
(AD-653986) CFSTI: HC $3.00/MF $0.65

Thermochemical research was carried out on ethylenimine, four aliphatic diamines, and two organic fluorine compounds. Results for ethylenimine include an experimental determination of its thermodynamic properties by means of low-temperature calorimetry, combustion calorimetry, and vapor pressure measurements. The measured third-law entropy is discussed in light of a recent Russian value calculated from spectroscopic information. Work on the thermochemistry of aliphatic diamines includes purification of samples of 1,2-diaminoethane, 1,2-diaminopropane, 1,2-diaminobutane, and 1,2-diamino-2-methylpropane; heats of combustion of 1,2-diaminopropane and 1,2-diamino-2-methylpropane; and some low-temperature thermal measurements on 1,2-diaminopropane. P-V-T relations determined for hexafluoroethane include vapor pressures up to the critical state, critical constants, Pc, Tc, and Vc, and compressibility of the gas up to 350C and 400 atmospheres. Preliminary values for the vapor heat capacity of hexafluorobenzene are presented. Author (TAB)

N67-33328# Mithras, Inc., Cambridge, Mass.

NO-O CHEMILUMINESCENCE STUDIES: FLIGHT AND WIND TUNNEL EXPERIMENTS Final Report, 18 Jan. 1966–17 Jan. 1967

R. Earl Good Jan. 1967 75 p refs
(Contract AF 19(628)-5825)
(MC-65-197-R2; AFCRL-67-0193; AD-653649) CFSTI: HC $3.00/MF $0.65

Upper atmosphere releases of nitric oxide trails were simulated in a wind-tunnel. The nitric oxide was released from a model into the low density tunnel flow of partially dissociated air. The radiant power produced was measured by photographic and photoelectric techniques. The tests were conducted at Mach numbers 1.99 and 3.27 and at stagnation pressures between 25 and 200 microns Hg, with known NO and O flow rates. Flight experiments were performed in June 1966. The design of the experiments was based on the wind-tunnel studies. A preliminary analysis of the flight data is given, based on the wind-tunnel studies. Author (TAB)

N67-33404# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

POLAROGRAPHY APPLIED TO THE DETERMINATION OF URANIUM OXIDE COMPOSITION [APPLICATION DE LA POLAROGRAPHIE A LA DETERMINATION DE LA COMPOSITION D'OXYDES D'URANIUM]

Chantal Nens, Claude Canton, and Roger Molina Mar. 1967 31 p refs In FRENCH
(CEA-R-3188)

An analytical method based on conventional polarography was developed for determination of the O/U ratio in uranium oxides. The dissolution of the samples is effected by means of molten ammonium bifluoride. After a transfer to aqueous solution, polarography is used to determine the oxide composition by measurement of both the hexavalent and the total uranium. Author (NSA)

N67-33414# Argonne National Lab., Ill.
STUDIES IN ZIRCONIUM OXIDATION
J. Levitan, J. E. Draley, and C. J. Van Drunen Dec. 1966 25 p refs
(Contract W-31-109-ENG-38)
(ANL-7252; ANL-7155) CFSTI: HC $3.00/MF $0.65

The oxidation of Zr at 550°, 700°, and 800°C, and at moderate pressures, followed rate laws that were between parabolic and cubic. Resistance measurements generally indicated electronic control of oxidation, although control during initial stages was partly ionic. The electric field across the growing scale exhibited a dependence on the partial pressure of O_2 in the low-pressure range. Gravimetric and volumetric measurements during low-pressure oxidation indicated a different mechanism: initial oxidation was linear, suggesting surface-reaction control. Interpretation in terms of an induction period is also suggested. Zr bearing a vapor-deposited Au film exhibited linear pressure dependence of oxidation for long times at moderate pressures. Measurements of potential and resistance during interaction of Zr with H_2O vapor, CO_2, and N_2 provided indications of the reaction mechanisms. Author (NSA)

N67-33453# Isochem, Inc., Richland, Wash.
GAMMA SCINTILLATION SPECTROMETRY
W. H. Zimmer Dec. 1966 64 p refs
(Contract AT(45-1)-1851)
(ISO-495) CFSTI: HC $3.00/MF $0.65

A method of analysis using gamma scintillation spectrometry is discussed. Equipment and methods of operation are described to assist in the establishment of a gamma energy analytical system, or to troubleshoot an existing system. The capabilities of the 7090 computer programs, MasMat (Master Matrix) and AMI (Analysis of Mixed Isotopes), are presented as one method of digesting the complex data generated. Author (NSA)

N67-33485# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS AND PROPERTIES OF POLYBENZIMIDAZOLES CONTAINING ALIPHATIC LINKS IN THE BASIC CHAIN
N. A. Adrova, M. M. Koton, A. M. Dubnova, Ye. M. Moskvina, Ye. I. Pokrovskiy et al. *In its* High Mol. Compds. 22 Mar. 1967 p 25–29 refs (See N67-33481 19-18)

A number of polyalkylendibenzimadazoles have been synthesized by polycondensation of 3,3'-diaminobenzidine with the phenyl esters of some aliphatic dicarboxylic acids. By increasing the number of methylene groups from 0 to 8 and by a combination of rigid heterocyclic groupings, high molecular weight thermostable polymers result which have a satisfactory combination of physicomechanical properties. M.W.R.

N67-33482 Library of Congress, Washington, D. C. Aerospace Technology Div.
PROPELLANTS AND COMBUSTION Surveys of Foreign Scientific and Technical Literature
Serge Markov and Boris Ofrossimow 28 Dec. 1966 74 p refs *Its* Compilation of Abstracts
(ATD-66-146; Rept.-1)

Soviet and other communist open source literature dealing with propellants and combustion is presented in a bibliography that includes 45 abstracts, one translation, and one book review. Entries are arranged alphabetically by authors, and an author index and a list of associations contributing to the bibliography are included. All of the entries are available at the Library of Congress. M.W.R.

N67-33495# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
ON THE INTERACTIONS BETWEEN CARBON MONOXIDE AND TRANSITION METALS [CONTRIBUTION A L'ETUDE DES INTERACTIONS DE L'OXYDE DE CARBONE ET DES METAUX DE TRANSITION]
Denis Abel Degras (Ph.D. Thesis—Paris Univ.) 23 Dec. 1966 140 p refs In FRENCH; ENGLISH summary
(CEA-R-3123) CFSTI: HC $3.00/MF $0.65

The sticking of carbon monoxide on surface atoms of transition metals is a collective phenomenon. According to the adsorption process period which is considered, this phenomenon may be formally described either by the Elovich equation or essentially from a steric point of view. The process rate depends upon the nature of the metal, the carbon monoxide pressure, the temperature, and the population densities of the induced and fundamental energy levels of the gas–solid bond. At least one of these induced levels tends to disappear with increasing time. For a localized adsorption and taking into account the surface Rayleigh waves, the analysis of the surface entropy yields the so-called isokinetic temperature for thermal desorption. This temperature is correlated with the cohesive energy of the metal surface atoms. Author

N67-33497# National Aeronautics and Space Administration, Washington, D. C.
RELATIONSHIP OF THE PHYSICAL PROPERTIES OF POLYARIMIDES TO THEIR CHEMICAL STRUCTURE
A. P. Rudakov, N. A. Adrova, M. I. Bessonov, and M. M. Koton Aug. 1967 6 p refs Transl. into ENGLISH from Dokl. Akad Nauk SSSR (Moscow), v. 192, no. 4, 1967 p 899–902
(NASA-TT-F-11158) CFSTI: HC $3.00/MF $0.65 CSCL 07C

A class of polyimides with aromatic nuclei at R and R', known as polyarimides, is discussed with respect to their chemical structure and main properties. General correlations between the properties of the polymer and the chemical structure of the monomer are established by dividing the polyarimides into four groups, basing the classification on the presence or absence of heteroatoms between the aromatic nuclei and on the position of such atoms relative to the imide rings. Physical and mechanical properties of the groups are plotted and tabulated. The main cause of the observed differences in properties is attributed to the structural features of the polyarimide chains and to the crosslinking or structuring after imidization. Author

N67-33501# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
PERCENTAGE DETERMINATION OF OXYGEN, NITROGEN, CARBON AND SILICIUM IN REFRACTORY METALS AND THEIR ALLOYS BY EMISSION SPECTROMETRY IN THE TAR U.V. SPECTRUM [DOSAGE DES ELEMENTS OXYGENE, AZOTE, CARBONE ET SILICIUM DANS LES METAUX REFRACTAIRES ET LEURS ALLIAGES, PAR SPECTROMETRIE D'EMISSION DANS L'ULTRAVIOLET LOINTAIN]
Frims Malamand 1967 43 p refs In FRENCH; ENGLISH summary
(ONERA-TN-105(1967)) CFSTI: HC $3.00/MF $0.65

The lines of the vacuum UV spectrum between 500 Å and 2000 Å used to determine simultaneously the percentages of

oxygen and nitrogen and of C and Si in the refractory metals (niobium, tantalum, and molybdenum) and in niobium alloys. The instrument includes a spark chamber, a spectrograph incorporating a grating at a pressure of 10^{-6} mm Hg, a high energy excitation source, and a direct reading system. For each element several lines are used. They correspond to high ionization levels O_{VI}, N_V, C_{IV}, and Si_{IV}, the ratios of the intentities being established by means of the intensity of the beam reflected by the grating. Concentrations of 10 ppm for O_2 and C, and of 20 ppm for N_2 are reached. These limits may still be lowered. The operational mode, the results obtained, and the advantages of this method are described in detail. Author (ESRO)

N67-33515# Atomic Energy Establishment, Trombay (India).
CATALYTIC EFFECT OF SOME IONS ON THE RATE OF THE REACTION BETWEEN PLUTONIUM (III) AND CHLORINE IN CHLORIDE SOLUTIONS
A. S. Ghosh Mazumdar, B. L. Gupta, and P. R. Natarajan 1967 12 p refs
(AEET-275)

The catalytic effect of copper (II), chromium (III), manganese (II), iron (III), nickel (II), arsenic (III), cerium (III) and sulfate ions on the oxidation of plutonium (III) to plutonium (IV) by chlorine in hydrochloric acid solutions has been studied. It has been found that only cupric and ferric ions show a positive catalytic effect while none of the other ions seems to have any significant effect. Author (NSA)

N67-33519# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE ANALYTIC STUDY OF FERRATES [CONTRIBUTION A L'ETUDE ANALYTIQUE DES FERRATES]
Nicole Bécarud (Ph.D. Thesis—Paris Univ.) 1966 43 p refs In FRENCH; ENGLISH summary
(CEA-R-2895)

Preparation and chemical properties of potassium, strontium and barium ferrates are described. Separation by glass-paper chromatography, electrochemical studies and infrared spectra are shown. A polarographic determination of ferrate ion was made. The stability of these compounds is studied with differential thermal analysis. Author

N67-33564# Atomic Weapons Research Establishment, Aldermaston (England).
THE β RADIOLYSIS OF DICHLORODIFLUOROMETHANE
P. M. S. Jones, R. Gibson, and P. J. Denny Dec. 1966 23 p refs
(AWRE-O-99/66) CFSTI: HC $3.00/MF $0.65

The availability of halogenated vacuum greases led to an interest in their interaction with tritium. To elucidate the products of radiolysis of this type of compound, the gas phase radiolysis of dichlorodifluoromethane was studied in the presence of tritium. The chief products were TCl and 1:4 dichlorooctafluorobutane with traces of CF_2ClT and $(CF_2Cl)_2$. The G-values have been measured and a mechanism proposed for the radiolysis involving ion-molecule reactions: $G(-CF_2Cl_2) = 8.0 \pm 0.1$, $G(TCl) = 8.5 \pm 0.1$.
Author (NSA)

N67-33565# Bureau of Mines, Albany, Oreg.
PURIFICATION OF TUNGSTEN HEXACHLORIDE
F. A. Skirvin, T. T. Campbell, and F. E. Block Jul. 1967 21 p refs
(BM-RI-6984)

Purification techniques were investigated for removing low-level metallic impurities from tungsten hexachloride. These techniques included distillation, fused-salt scrubbing, zone refining, and adsorption. Fractional distillation of tungsten hexachloride was found to be an effective purification method. The impurity levels of molybdenum, iron, nickel, copper, magnesium, and manganese were reduced to provide a tungsten halide sample which contained a total of less than 10 ppm detectable metallic impurities. Purification by fused-salt scrubbing of tungsten hexachloride in a lithium chloride–potassium chloride eutectic produced a hexachloride product which was of approximately the same quality as that obtained by distillation. Zone refining and adsorption did not appear to be as effective as distillation or fused-salt scrubbing. Author

N67-33559# Southern Research Inst., Birmingham, Ala.
SURFACE TENSION, VISCOSITY, AND RAMAN SPECTRA OF FUSED SALTS Final Report, Jun. 1956–Nov. 1966
R. B. Ellis 14 Apr. 1967 36 p refs
(Contract AT(40-1)-2073)
(ORO-2073-12) CFSTI: HC $3.00/MF $0.65

Some physical properties of fused salts were measured, and the resulting data were interpreted in terms of the structure of the molten state. Densities were measured as needed in the work on surface tension and viscosity. A minor effort was spent in the measurement of the interfacial tension between molten salts and molten metals. An empirical correlation between the surface tension of alkali metal and alkaline earth metal halides and some fundamental properties of the compounds was developed. The variations in surface tension of several mixtures of salts with composition and with temperature were studied. Most of this work was done on the reciprocal system K^+, Cd^{2+}/Cl^-, Br^-. The results suggested the existence of complex ions in the surface. The nature of the associated species was identified by means of Raman spectroscopy. The viscosities of cadmium halide–potassium halide systems were also investigated. Raman spectra of zinc halide melts not only identified the highly associated species in pure zinc halides but also established the presence of both tri-halo and tetra-halo complexes. NSA

N67-33584# Idaho Nuclear Corp., Idaho Falls.
A RAPID SOURCE PREPARATION TECHNIQUE FOR HIGH-RESOLUTION ALPHA PARTICLE SPECTROSCOPY
R. A. Deal and R. N. Chanda Apr. 1967 12 p refs
(Contract AT(10-1)-1230)
(IN-1081) CFSTI: HC $3.00/MF $0.65

A rapid method was developed for the preparation of sources for high-resolution alpha particle spectroscopy. The method involves the extraction of a nuclide into an organic phase. An aliquot of the organic is then transferred to a counting plate, evaporated to dryness, and finally ignited leaving a mass-free plate. Sources prepared in this manner are of quality equal to other methods currently in use. Author (NSA)

N67-33582# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures and Refractories.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE
J. J. Diamond ed. (NBS) Mar. 1967 93 p refs *Its* Vol. 1967, No. 1

A bibliography on high temperature chemistry and physics covering the following areas is presented: (1) devices for achieving, measuring, and controlling temperatures above 1500°C; (2) devices for physical measurements at temperatures above 1000°C; (3) properties, at temperatures below 1000°C, of materials which melt

above 1500°C; (4) properties, at temperatures above 1000°C, of materials which melt above 1500°C; (5) properties, at temperatures above 1000°C, of materials which melt below 1500°C; (6) phase equilibria; and (7) reactions at temperatures above 1000°C.
C.T.C.

N67-33648*# National Aeronautics and Space Administration, Washington, D. C.
PHASE DIAGRAM OF THE SYSTEM Ti-P [DIAGRAMMY SOSTOYANIYA SISTEMY Ti-P]
V. N. Yeremenko and V. Ye. Listovnichiy Aug. 1967 7 p refs Transl. into ENGLISH from the book "Novye Issledovaniya Titanovykh Splavov" Moscow, Izdatel'stvo Nauka, 1965 p 20–24
(NASA-TT-F-11162) CSCL 07B

Physicochemical analysis of the interaction between titanium and phosphorus in mixtures containing up to 45 at.% P. The existence of the phases Ti_3P, Ti_2P, Ti_3P_2, Ti_4P_3, and TiP is established and the regions of homogeneity and certain properties of these compounds are determined. It is shown that the hypothetical phase diagram of this system, as plotted by Vogel and Giessen, is incorrect. From the results of the study a phase diagram of the system Ti-P with up to 45 at.% P is plotted.
Author

N67-33650# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS OF ACETYLENE IN A PLASMA JET
S. Mints, A. Shiman'ski, and S. Varykha 22 Mar. 1967 8 p refs Transl. into ENGLISH of the Monograph "Sintez Atsetilena v Struye Plazmy" Moscow, 1965 p 1–8 Presented at the Intern. Congr. on Theoret. and Appl. Chem.
(FTD-MT-65-540; TT-67-62107; AD-653539) CFSTI: HC $3.00/MF $0.65

The invention and practical use of a new type of electric discharge—the vortex gas stabilized arc discharge—have opened a new approach to the study of several chemical endothermic processes, one of which is synthesis of acetylene from methane in an argon plasma jet. The acetylene content in effluent gases reaches 12%, which indicates that in case of reduction of energy consumption per 1 cu m (NTP) this technique may successfully compete with other methods of acetylene production. The study was conducted to determine the best conditions of conversion of methane into acetylene in an argon plasma jet. A plasma jet equipped with a tungsten cathode and copper anode (nozzle) was investigated. Methane was introduced just below the anode or directly into the nozzle. The post-reaction mixture was cooled in a water cooler attached directly to the anode. Results of investigations indicated that for power input between 6 and 10 kw and at constant argon flow the best efficiency is obtained for methane content from 20 to 35%. For these conditions the power yield of 22 kw-hr/cu m (NTP) of acetylene was obtained. The conversion of methane to acetylene was then between 50 and 80%. Influence of method and place of methane feeding and cooling arrangement on efficiency of the process was observed.
Author (TAB)

N67-33654# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
MASS SPECTROMETER INTRODUCTION LINE: APPLICATION TO THE ANALYSIS OF IMPURITIES IN URANIUM HEXAFLUORIDE [LIGNE D'INTRODUCTION POUR SPECTROMETRE DE MASSE: APPLICATION A L'ANALYSE DES IMPURETES CONTENUES DANS L'UF_6]
Marc Besson Jan. 1967 124 p refs In FRENCH
(CEA-R-3132)

The continuous mass-spectrometric analysis of impurities in UF_6 is possible industrially if certain conditions imposed by the nature of the gas are respected. The gas introduction line arriving at the spectrometer's source makes it possible to fix the flow rate, to control the inlet pressure, and to selectively destroy the gas containing the impurities. Operational conditions for the line are defined and a description is given of theoretical and experimental studies of the various elements of which it is composed, i.e., the leak valve, the flowmeter, the chemical trap, and the servomechanism making it possible to regulate and control the gas flow. The dynamic characteristics of the line's various components and the performance of the equipment in the case of the analyses considered are given.
Author (NSA)

N67-33655# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
SPECTROPHOTOMETRIC TITRATIONS: APPLICATION TO THE DETERMINATION OF SOME ELEMENTS IN URANIUM SOLUTIONS [LES TITRAGES SPECTROPHOTOMETRIQUES: APPLICATION A LA DETERMINATION DE QUELQUES ELEMENTS DANS LES SOLUTIONS D'URANIUM]
Maurice L'Her (Ph.D. Thesis—Univ. of Paris) Jan. 1967 116 p refs In FRENCH
(CEA-R-3140)

Application of spectrophotometric titrations to the analysis of uranium-containing solutions is discussed. The general principles involved in these titrations are outlined. Spectrophotometric titrations are first considered from a general point of view; their fundamental principle and practical execution, as well as the various possibilities of the method, are examined. Advantages of titration are examined, in particular that of lending itself simultaneous determination of two species. The possibility of applying these spectrophotometric titrations to the analysis of uranium-containing solutions is considered: the dosage of a few species in uranium (VI) solutions is described. In an experimental appendix the equipment is described.
Author (NSA)

N67-33688# Army Materials Research Agency, Watertown, Mass.
ION EXCHANGE ANALYSIS OF COLUMBIUM ALLOYS
Thomas A. Ferraro Jun. 1967 25 p refs
(AMRA-TR-67-17; AD-653768) CFSTI: HC $3.00/MF $0.65

An ion-exchange method developed at AMRA (see AD-653 767) was applied to the analysis of synthetic mixtures representing various columbium-base alloys. The alloying elements which were separated and determined include vanadium, zirconium, hafnium, titanium, molybdenum, tungsten, and tantalum. Mixtures containing zirconium or hafnium, tungsten, tantalum, and columbium were separated by means of a single, short column. Coupled columns were employed for the resolution of mixtures containing vanadium, zirconium or titanium, molybdenum, tungsten, and columbium. The separation procedures and the methods employed for the determination of the alloying elements in their separate fractions are described.
Author (TAB)

N67-33690# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS OF POLYMERS CONTAINING FERROCENE-NITROGEN WITH A SYSTEM OF CONJUGATED BONDS [SINTEZ FERROTSENAZOTSODERZHASHCHIKH POLIMEROV S SISTEMOY SOPRYAZHENNYKH SVYAZEY]
T. R. Vishnyakova, I. A. Golubeva, and Ya. M. Paushkin 21 Feb. 1967 13 p refs Transl. into ENGLISH from Vysokomol. Soedineniya (USSR), v. 8, no. 1, 1966 p 181–185
(FTD-HT-66-416; TT-67-62136; AD-653957) CFSTI: HC $3.00/MF $0.65

New ferrocene- and nitrogen-containing polymers-polyferrocenylnitriles- were prepared by polycondensation of amides or ammonium salts of ferrocenecarboxylic acids. The reaction was

conducted in an autoclave in the absence of atmospheric oxygen and in the presence of ZnCl2 catalyst. Polyferrocenylnitrile was prepared at 170-200C from ferrocenecarboxamide, ammonium ferrocenecarboxylate, as well as from ferrocene proper. Polyferrocenyldinitrile was also prepared at 200C from 1,1'-ferrocenedicarboxamide and from diammonium 1,1'-ferrocenedicarboxylate. All the polymers were black to brown powders. Structures were confirmed by IR spectroscopy. The temperature dependence of conductivity of the polymers was exponential in character. Author (TAB)

N67-33718# Jefferson Medical Coll., Philadelphia, Pa.
SPECIALIZED RESPONSES TO IONIZING RADIATION, PARTS I AND II Third Year Progress Report, Jan. 1, 1966–Jan. 1, 1967
Gary S. Shaber 30 Apr. 1967 27 p
(Contract AT(30-1)-3359)
(NYO-3359-3) CFSTI: HC$3.00/MF$0.65

Progress is reported on studies of fibrinogen deposition and taste thresholds in x-irradiated rats. External whole-body x irradiation produced an increase in whole-body fibrinogen turnover and blood turnover up to a dose of 600 R. At higher doses the whole-body fibrinogen turnover decreased much more rapidly than did the blood fibrinogen turnover. ϵ-Aminocaproic acid produced the same effect, however, at lower dosages, which seems to imply that the body normally maintains fibrinogen turnover equilibrium through the fibrinolysin system even at relatively high X-ray doses. However, the system breaks down at extremely high doses; and the body is unable to cope with the extravascular deposition of fibrinogen. Possible mechanisms for the reaction are discussed. The taste threshold for saccharin in x-irradiated (50 rad to tongue) rats was found to be 0.0010%. Daily variation in the taste threshold for saccharin was minimal. A change in taste threshold in two animals that received 50 rad of head irradiation persisted from 1 hr to 6 days postirradiation. Three papers published during the report period are listed. NSA

N67-33726# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie.
STUDIES ON NUCLEAR-TECHNOLOGY APPLICATION OF COLUMN CRYSTALLIZATION AND COMPARISON WITH ZONE-MELTING METHODS [STUDIEN UEBER DIE KERNTECHNISCHE ANWENDUNG DER KOLONNENKRISTALLISATION UND VERGLEICH MIT DEM ZONENSCHMELZVERFAHREN]
R. v. Ammon Oct. 1966 30 p refs In GERMAN
(KFK-502)

Zone melting and column crystallization were compared as methods for separation in the system KNO_3–$NaNO_3$, the binary eutectic KCl–LiCl, the ternary eutectic $MgCl_2$–NaCl–KCl, and the binary eutectic UCl_4–KCl. The results showed that both purification methods are in principle well suited for inorganic fused salt separations. Both methods have advantages and disadvantages. Zone melting is well suited for fine purification of sensitive substances but requires a long period of time and can handle only small amounts. Column crystallization on the other hand is rapid and is suitable for large throughputs. It has the best separation efficiency in systems in which the components are in large concentrations. It has, however, great mechanical problems for melts with high freezing points and high corrosion. NSA

N67-33727# Oak Ridge National Lab., Tenn.
HYPERFILTRATION WITH DYNAMICALLY-FORMED MEMBRANES
Kurt A. Kraus, Arthur J. Shor, and James J. Johnson, Jr. [1967] 38 p refs Presented at 2d European Symp. on Fresh Water from the Sea, Athens
(Contract W-7405-ENG-26)
(ORNL-P-2961; CONF-670509-1) CFSTI: HC$3.00/MF$0.65

The dynamic formation of salt-rejecting membranes on porous supports from appropriate additives in the feed solutions is discussed. Requirements of membranes for salt rejection are reviewed. The properties of dynamic ion exchange membranes are demonstrated using ZrO_2. Other dynamic membranes, such as hydrous Fe_2O_3, humic acid, bentonite, organic polyelectrolytes, and polyvinyl pyridine are also discussed briefly. NSA

N67-33729# Nuclear Materials and Equipment Corp., Lewiston, N. Y. Niagara Div.
THE PURIFICATION OF BF_3-DIMETHYL ETHER COMPLEX FEED THROUGH THE USE OF AN ACTIVATED CHARCOAL COLUMN
Weldon F. Williams and E. R. Shuster 1 Dec. 1966 20 p
(Contract AT(40-1)-3292)
(NUMEC-3292-1) CFSTI: HC$3.00/MF$0.65

A method is described for the partial removal of decomposition products and impurities in BF_3-dimethyl ether complex. Color is removed and decomposition products (primarily methyl borate) are decreased by passing the complex through an activated charcoal column. The determination of adsorption isotherms for various charcoals showed a great difference in performance from brand to brand. A small quantity of extremely good purity was produced followed by a considerably larger withdrawal of products showing some improvement, but indicating the rapid establishment of an equilibrium between the feed and impurities. Author (NSA)

N67-33731# National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, VOLUME 1966, NO. 4, OCTOBER–DECEMBER 1966
J. J. Diamond, ed. Dec. 1966 75 p refs
(NP-16584) Available from Natl. Bur. of Standards

References are included on devices for achieving, measuring, and controlling temperatures above 1500°C, devices for physical measurements at temperatures above 1000°C; properties, at temperatures above and below 1000°C, of materials which melt above and below 1500°C; phase equilibria; and reactions at temperatures above 1000°C. NSA

N67-33762# Naval Research Lab., Washington, D. C.
DIFFUSION OF METHYL CHLOROFORM
F. E. Saalfeld and M. V. McDowell *In its* The Present Status of Chem. Res. in Atmosphere Purification and Control on Nucl.-Powered Submarines 11 Jan. 1967 p 4–7 refs (See N67-33761 19-05)

The diffusion rates of methyl chloroform through insulation and decorative materials cemented to aluminum surfaces with an adhesive were investigated using a mass spectrometric method. Measurements showed that methyl chloroform trapped behind surface covered corkboard diffuses into the atmosphere at a slow rate (about 2.5×10^{-6} lb/day-ft^2) for an extended length of time (more than 6 months). Inch-thick Ensolite retained methyl chloroform longer than half-inch Ensolite or corkboard whose surface has not been covered with smoothing cement. Methyl chloroform passed through uncovered corkboard faster than any other of the materials studied. No chlorinated hydrocarbon could be detected diffusing through the decorative laminates. S.C.W.

N67-33780# Los Alamos Scientific Lab., N. Mex.
SHOCK TUBE STUDY OF THE EFFECTS OF NITROGEN AND WATER VAPOR ON RECOMBINATION IN THE HYDROGEN–OXYGEN SYSTEM
R. W. Getzinger and L. S. Blair [1966] 15 p refs Presented at the 6th Intern. Shock Tube Symp., Freiburg
(Contract W-7405-ENG-36)
(LA-DC-8441; CONF-670407-1) CFSTI: HC$3.00/MF$0.65

Shock tube studies were made on the effects of N_2 and H_2O vapor on recombination in the H_2–O_2 system in argon. The nitrogen experiments were made at 1518 to 1912°K and the water vapor experiments at 1259 to 1550°K. Nitrogen was found to be more efficient than argon in promoting the reactions between H_2 and O_2 by less than a factor of 2. Chemical reactions involving N_2 were too slow at the temperatures studied to have influenced the results much. It is believed that in an atmosphere containing 1% or more water vapor vibrational relaxation of N_2 can be assumed to have taken place before any significant amount of recombination has occurred. NSA

N67-33833*# Oklahoma State Univ., Stillwater.
EDUCATIONAL MONOGRAPHY PREPARED FROM A GENERAL METHOD FOR AUTOMATIC COMPUATION OF EQUILIBRIUM COMPOSITIONS AND THEORETICAL ROCKET PERFORMANCE OF PROPELLANTS
K. C. Chao Feb. 1967 34 p refs See NASA-TN-D-132
(Contract NSR-37-002-045)
(NASA-CR-87324; TD-1-67) CSCL 07D

Calculation of chemical equilibria in a complex reaction system is carried out in an iterative manner on computers. For this purpose the basic equations expressing equilibrium conditions are arranged systematically. The equations are linearized. The linearized equations are solved by the Crout reduction method. General equations are given for the determination of equilibrium temperature and composition at specified pressure and enthalpy. The procedures are illustrated with a reasonably complex reaction mixture. Author

N67-33866*# Farnham (Frank C.) Co., Philadelphia, Pa.
A STUDY OF THE COMBINED ACTION OF RADIATION AND OXIDE CATALYSTS ON THE DEHYDROGENATION OF CYCLOHEXANE [IZUCHENIYE SOVMESTNOGO DEYSTVIYA RADIATSII I OKISNYKH KATALIZATOROV NA REAKTSIYU DEGIDRIROVANIYA TSIKLOGEKSANA]
V. I. Vladimirova, G. M. Zhabrova, B. M. Kadenatsi, V. B. Kazanskiy, and G. B. Pariyskiy Washington, NASA, Jul. 1967 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 148, no. 1, 1963 p 101–104
(Contract NASw-1496)
(NASA-TT-F-11109) CSCL 07C

Although it has long been known that exposure of various catalysts to radiation affects their catalytic properties, the action mechanism is not clear. Described is an attempt to clarify this mechanism by comparing the effects of irradiation on catalysts possessing different properties. Low temperature dehydrogenation of cyclohexane was the reaction chosen for study, and the catalysts included oxide insulators, low conductivity semiconductors and *n* and *p* high conductivity semiconductors. The reaction products were studied and electron paramagnetic resonance spectra were recorded. Results indicated that the poorest semiconductors have the greatest radiation-catalytic activity. These findings are related to the electronic properties of the materials. Author

N67-33898# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
A FEASIBILITY STUDY: FORMATION OF URANIUM NITRIDE COMPOUNDS USING CHEMICAL-VAPOR DEPOSITION TECHNIQUES
W. C. Robinson, Jr. and W. R. Martin May 1967 10 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1812) CFSTI: HC $3.00/MF $0.65

The feasibility of the direct gas phase reduction of UF_6 to U metal according to the reaction: $UF_6(g)+6Li(g) \rightarrow U(s)+6LiF(g)$ was demonstrated. N_2 was then introduced into the chamber simultaneously with UF_6 and Li vapor to form a U–N compound. At temperatures and pressures selected, thermodynamic data indicate U nitrides to be stable. The reaction produced UN, UN_2, U, LiF, and other complex (U, Li, F) compounds. It was proved possible to form U nitrides by this technique; however, clean separation of the desired material and the reaction products was not feasible in the apparatus used. Author (NSA)

N67-33901# Pennsylvania State Univ., University Park. Materials Research Lab.
CRYSTAL CHEMISTRY STUDIES Quarterly Report, 14 Nov. 1966–13 Feb. 1967
Rustum Roy, Gregory J. McCarthy, Olaf Muller, and William B. White Apr. 1967 46 p refs
(Contract DA-28-043-AMC-01304(E))
(ECOM-01304-7; QR-7; Rept.-7; AD-650218) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. CRYSTAL CHEMISTRY AND PHASE EQUILIBRIA IN THE SYSTEM Eu–Ti–O G. J. McCarthy, W. B. White, and R. Roy p 7–13 refs (See N67-33902 19-06)

2. PHASE EQUILIBRIA IN THE SYSTEMS NiO–Cr_2O_3–O_2, MgO–Cr_2O_3–O_2 AND CdO–Cr_2O_3–O_2 AT HIGH OXYGEN PRESSURES. I: PHASE RELATIONSHIPS O. Muller, R. Roy, and W. B. White p 15–44 refs (See N67-33903 19-06)

N67-33902# Pennsylvania State Univ., University Park. Materials Research Lab.
CRYSTAL CHEMISTRY AND PHASE EQUILIBRIA IN THE SYSTEM Eu–Ti–O
Gregory J. McCarthy, William B. White, and Rustum Roy *In its* Crystal Chem. Studies Apr. 1967 p 7–13 refs Presented at the 6th Rare Earth Res. Conf., Gatlinburg, Tenn., 3–6 May 1967 (See N67-33901 19-06)

The experimental procedures are briefly outlined, and the problems connected with the container and starting materials are mentioned. Among the results are the following: Eu_2O_3–TiO_2 binary has a cubic pyrochlore and an equimolar phase. A $(Eu,Ti)O_x$ crystalline solution with a moderately wide stability field was noted at the Ti-rich end of the ternary diagram. Eu_2O_3 and EuO appear to accept little Ti. The EuO–TiO join is apparently not binary. $EuTiO_3$ is found to exist in two- and three-phase regions. It is also reported that a group of iron glasses were prepared and polished, and their optical spectra were measured for the investigation on site distribution of transition metal cations in glass. N.E.N.

N67-33903# Pennsylvania State Univ., University Park. Materials Research Lab.
PHASE EQUILIBRIA IN THE SYSTEMS NiO–Cr_2O_3–O_2, MgO–$Cr_2O_3O_2$ AND CdO–Cr_2O_3–O_2 AT HIGH OXYGEN PRESSURES. I: PHASE RELATIONSHIPS
Olaf Muller, Rustum Roy, and William B. White *In its* Crystal Chem. Studies Apr. 1967 p 15–44 28 p *Its* 4th Tech. Appendix (See N67-33901 19-06)

Experimental investigations of the systems at high oxygen pressures are reported. The general methods of preparation and the characterization of starting materials are outlined, and phase diagrams are presented. Two intermediate phases were found in the nickel system, three in the magnesium system, and four in the cadmium system. No tetravalent chromium compounds were noted. Details are given on the properties and structure of each system and their intermediate phases. The dissociation pressures and temperatures, and the reaction mechanisms are briefly discussed. N.E.N.

N67-33935# Army Materials Research Agency, Watertown, Mass.
SEPARATION OF VANADIUM, ZIRCONIUM, TITANIUM, MOLYBDENUM, TUNGSTEN, AND COLUMBIUM BY ELUTION DEVELOPMENT ION EXCHANGE CHROMATOGRAPHY
Thomas A. Ferraro Apr. 1967 36 p refs
(AMRA-TR-67-10; AD-653767) CFSTI: HC $3.00/MF $0.65

The elution behavior of vanadium, zirconium, titanium, molybdenum, tungsten, and columbium was studied at various hydrofluoric acid concentrations employing a strong base anion exchange resin. The results of this study were used to establish appropriate separation schemes. Coupled columns were employed for the separation of the complete group. Simple columns were used for less complicated mixtures. Vanadium, zirconium, titanium, and molybdenum were eluted with appropriate hydrofluoric acid solutions. In this way, interference from large amounts of columbium was avoided. An 'interval' equation defining the desired volume interval between successively eluting solutes is offered for calculating the column length required for a particular separation. This equation is especially useful for determining the extent to which a column must be lengthened when overlapping occurs due to high column loading. Author (TAB)

N67-33965 Joint Publications Research Service, Washington, D. C.
ELECTRON PARAMAGNETIC RESONANCE AND MAGNETIC SUSCEPTIBILITY OF Cu (II) COMPOUNDS WITH DICARBOXYLIC ACIDS
Yu. V. Yablokov 21 Jul. 1967 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 173, no. 5, 1967 p 1136–1138
(JPRS-41925; TT-67-32556) CFSTI: $3.00

Fine crystalline specimens were used to study the electron paramagnetic resonance of Cu(II) compounds with maleic, succinic, orthophthalate, and terephthalic acids at frequencies of 9250 and 9470 megacycles; and the magnetic susceptibility of cuprous terephthalate and cuprous maleate was determined from room temperature to 77°K. The observed electron paramagnetic spectrum is associated with transition in the excited triplet state with effective spin of one, and the value at which the triplet level is split into singlet and doublet somewhat exceeds the energy of the radiofrequency quantum. Pairs of copper atoms in cuprorus succinate associated with direct exchange interactions are analogous to those in cuprous acetate monohydrate, and exchange-bound pairs of copper atoms were detected in cuprous orthophthalate. Cuprous maleate differs from cuprous succinate by a double bond between the central carbon atoms. The absence of dimers in copper compounds with dicarboxylic acids in which carboxyl groups are found in a system of conjugated bounds is not considered to be a random occurrence. M.W.R.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-32715*# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
OPTIMUM FREQUENCY MODULATION RECEIVERS
Allan Guida and Donald L. Schilling [1967] 28 p refs
(Grant NGR-33-006-020)
(NASA-CR-87056; T-3) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The maximum likelihood equation for demodulating an FM signal corrupted by additive gaussian noise is derived and examined. Asymptotic formulas for the signal-to-noise ratio of the maximum likelihood estimate are calculated for high carrier-to-noise ratio and infinite observation time. The results show that the FM discriminator is approximately equivalent to the maximum likelihood estimator at high carrier-to-noise ratios. An iterative method for solving the maximum likelihood equation at any carrier-to-noise ratio is presented. It is noted that the difference between optimum FM receivers and non-optimum FM receivers lies mainly in the number of spikes per second present in the output of these receivers. The problem of spike detection is considered and a spike detector is designed for an FM discriminator. Two simple FM receivers are analyzed using appropriate auto-correlation functions and spectral densities. The results are compared to the FM discriminator. Author

N67-32734# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.
USE OF FLUORESCENT MATERIALS AND ULTRAVIOLET LIGHTING TO CONTROL VISUAL SIMULATION MODEL LIGHTING FOR TELEVISION IMAGE PICKUP Technical Report, Feb.–Oct. 1966
Richard J. Heintzman 1 Nov. 1966 23 p
(SEG-TR-66-66; AD-652838) CFSTI: HC $3.00/MF $0.65

Lighting the models used in visual simulation often entails many problems. For a monochrome television system of image display, proper contrast depends upon lighting the model, the color hues of the model, the reflectance and shading, and the spectral response of the television camera. In the test reported, an attempt was made to control image contrasts by controlling the spectral range of the reflected image through use of fluorescent coatings and ultraviolet light. Also, filters were used for controlling extraneous reflections. The efficiency of conventional lighting and reflecting material is compared with that of ultraviolet lighting and fluorescent material. Fluorescence for simulation models offers the greatest advantages for applications that have a limited area of interest, such as in vehicle simulation; there is little advantage when applied to large areas, such as those of terrain models. Author (TAB)

N67-32753# Lincoln Lab., Mass. Inst. of Tech., Lexington.
TRAJECTORY EQUATIONS OF MOTION IN RADAR POLAR COORDINATES
Sebastian F. Catalano 24 May 1967 17 p refs
(Contract AF 19(628)-5167; ARPA Order 498)
(ESD-TR-67-276; TN-1967-25; AD-652841) CFSTI: HC $3.00/MF $0.65

The equations of motion of a body under the influence of the earth's gravity and atmospheric drag are obtained in radar polar coordinates. The choice of this coordinate system may have important advantages in various tracking and filtering algorithms. A rotating ellipsoidal earth with gravitational terms up through the second (easily extendable) harmonic is assumed. The effects of a non-spherical earth along with the corresponding effects of the higher gravitational harmonics can be important in the estimation of ballistic coefficients at very low deceleration levels. Author (TAB)

N67-32758* Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
TAPPED DELAY LINE SIMULATION OF RANDOMLY TIME-VARIANT CHANNELS
C. C. Bailey Sep. 1966 51 p refs
(Grant NsG-553)
(NASA-CR-87162; CSCL 09D

A theory for representation of randomly time-variant channels is outlined and applied to the development of a tapped delay line

method of simulating such channels. Some experimental results obtained with a tapped delay line simulator are also presented. Definitions are given of the appropriate functions needed to specify randomly time-variant systems. Attention is also given to determining how closely the delay line system approximates the mathematical model it is supposed to represent. The linear delay distortion and linear amplitude distortion parameters associated with a channel are defined, and the equations necessary to compute them on the digital computer are derived. The theory is used with a model of a tropospheric scatter channel to design a digital computer simulator for troposcatter channels. Some experimental results obtained with this simulator are presented. Author

N67-32759# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF ANTENNA RADIATION PATTERNS WITH THE HELP OF A HELICOPTER
N. D. Dymovich 20 Mar. 1967 16 p refs Transl. into ENGLISH from Sudovozhdeniye i Svyaz' No. 23. Inform. Sb. Vypsuk 98 (USSR), 1963 p 79–87
(FTD-MT-65-411; TT-67-62014; AD-652469) CFSTI: HC $3.00/MF $0.65

The measurement of antenna radiation patterns may be carried out with helicopters. The helicopter, due to its ability to hover for some time in the air and to move at low velocities, offers a convenient—and in some cases, the only—method for taking antenna radiation patterns. For example, when the locality around the antenna being studied is cut up into several sections, covered with trees and swamps, or when it is necessary to measure the radiation pattern of an antenna on a ship, it is extremely difficult to make the measurements from the ground. Aircraft are unsuitable because of their flying too fast. This article concerns using a helicopter while measuring patterns of cophasal and rhombic antennas. Author (TAB)

N67-32796 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMMUNICATIONS NETWORKS. PART I: REVIEW OF SOVIET LITERATURE Surveys of Foreign Scientific and Technical Literature
Wladimir Podpaly and Wallace Cretan 6 Jul. 1966 78 p refs Compilation of Abstracts
(ATD-66-96; Rept.-6; AD-647577) CFSTI: HC $3.00/MF $0.65

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1. COMMUNICATIONS EQUIPMENT W. Podpaly and W. Cretan p 1–38 refs (See N67-32797 19-07)
2. COMMUNICATIONS FACILITIES AND THEIR LOCATION W. Podpaly and W. Cretan p 39–46 refs (See N67-32798 19-07)

N67-32797 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMMUNICATIONS EQUIPMENT
Wladimir Podpaly and Wallace Cretan *In its* Commun. Networks, Pt. I 6 Jul. 1966 p 1–38 refs (See N67-32796 19-07)

Presented are abstracts based on Soviet open sources published mainly in 1965. The 25 entries on communications equipment cover the following: (1) radio transmitter–receiver equipment, including a portable voice transceiver and an antenna matching device; (2) plant intercom, loudspeaker, and telephone equipment, including switchboards and power supply for dial exchanges; (3) production of communications equipment in Hungary; (4) reliability of long-distance cables, telegraph channels, and electronic tubes; (5) facsimile equipment for halftone copy; and (6) telephone and voice-frequency radio equipment for trains and railroad facilities. Overall development of Soviet facsimile equipment is reviewed separately; this review includes 12 references and several tables and illustrations. K.W.

N67-32798 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMMUNICATIONS FACILITIES AND THEIR LOCATION
Wladimir Podpaly and Wallace Cretan *In its* Commun. Networks, Pt. I 6 Jul. 1966 p 39–46 refs (See N67-32796 19-07)

Eight abstracts based on Soviet open sources published in 1965 are presented. Of these articles, seven are concerned with railroad communications, while the remaining one describes a high-speed data transmission system that utilizes existing telephone lines. The articles on railroad communications treat the following: (1) data transmission to railroad computer centers; (2) communication facilities on ac electrified tracks; (3) problems during changeover to electrification in signal and communications equipment on railroad lines; (4) history of Soviet progress in the development of railroad signal and communications equipment; (5) multiplexing capability of nonloaded underground railroad communications cables, and (6) voice-frequency railroad communication lines replacing insulated conductors over alkaline soil. K.W.

N67-32801# Ford Instrument Co., Long Island City, N. Y.
ANTENNA UNIT AND SIGNAL SPECTRUM ANALYZER Final Report
S. N. Smilowitz San Francisco, Naval Radiological Defense Lab., Oct. 1966 99 p
(Contract N228(62479)65682)
(USNRDL-TRC-67-17; AD-653898) CFSTI: HC $3.00/MF $0.65

The report presents a detailed description of the design and test evaluation of a breadboard system capable of detecting transient electromagnetic signals and determining the dominant spectral frequencies of these signals. The equipment is designed to process signals varying in amplitude over a 1000 to 1 range, and lasting for time intervals of less than 175 microseconds. The system indicates the dominant spectral frequency component within 10 milliseconds after the signal has been detected. Author (TAB)

N67-32856# Harry Diamond Labs., Washington, D. C.
SOME CURRENT DISTRIBUTIONS FOR SLOT ARRAYS ON THE CIRCUMFERENCE OF A CYLINDER
Harry K. Morlock Feb. 1967 15 p refs
(HDL-TM-67-1; AD-652875) CFSTI: HC $3.00/MF $0.65

Current distributions are calculated which when used to feed an array of slots on the circumference of a 9-ft diameter cylinder produce one main beam with all other lobes suppressed more than 20 db. Patterns are calculated for 10-, 20-, 30-, and 40-element arrays. Half- and tenth-power beam widths are tabulated for each array. Author (TAB)

N67-32861# Harry Diamond Labs., Washington, D. C.
DOPPLER WAVE RECOGNITION WITH HIGH CLUTTER REJECTION
H. P. Kalmus Apr. 1967 22 p
(HDL-TR-1349; AD-652878) CFSTI: HC $3.00/MF $0.65

A Doppler Radar is described which makes it possible to detect moving targets deeply embedded in clutter noise. The system is based on the use of quadrature detection and a new low level correlator. Most of the required amplification takes place after correlation and integration so that amplifier overloading can be avoided. Author (TAB)

N67-32864# Stromberg-Carlson Corp., San Diego, Calif.
AN INVESTIGATION OF TARGET ENHANCEMENT THROUGH USE OF A MULTI-PHOSPHOR CATHODE RAY TUBE Final Report
R. S. French 5 May 1967 65 p refs
(Contract Nonr-4931(00))
(Rept.-9991021; AD-652980) CFSTI: HC $3.00/MF $0.65

Utilizing a specially manufactured multi-phosphor cathode-ray tube (CRT), this study investigated the hypothesis that target detectability on a simulated radar/sonar-type display is enhanced if the target abruptly changes color as it moves across the display. A secondary objective of the study was to obtain information on the relative detectability of the target in each of the eight phosphors tested. The task for each of 52 Navy sonar school students was the detection of a moving target imbedded in visual noise. The special design multi-phosphor CRT contained eight commonly used radar and television phosphors arranged in wedge-shaped sectors around the tube face. The subjects task was to scan the entire tube face during the brief period of target presentation and to determine in which phosphor the target appeared. The test consisted of 64 trials during which two experimental conditions were presented on alternate trials. Under one set of conditions, the target appeared at a sector boundary and moved 45 degrees to an adjacent sector boundary, entirely within a given phosphor color. Under the alternate set of conditions, the target appeared at the medial line of a sector and moved to the medial line of an adjacent sector, resulting in an abrupt change of color midway in the target path. The major sources of variance tested were: (a) color-change/no-color-change, (b) orientation of the tube face, (c) phosphor differences, and (d) clockwise/counterclockwise rotation of the target. The results of the study showed that the no-color-change condition enhanced detectability when compared to the color-change condition. Author (TAB)

N67-32877# Naval Research Lab., Washington, D. C.
ON THE SCIENTIFIC USE OF A SATELLITE RADAR SYSTEM Final Report
Sandra J. Rutiser and John M. Goodman Apr. 1967 44 p refs
(NRL-MEMO-1768; AD-653065) CFSTI: HC $3.00/MF $0.65

The possible scientific uses of a satellite radar system are evaluated and several experiments are discussed. Synoptic studies of field-aligned ionization associated with radio aurora, the detection of shower meteors, and further investigation of the ionospheric electron content with such a system appear to show considerable promise. The study of satellite precursors and wakes might also be accomplished by a satellite radar system employing a radar frequency in the neighborhood of 30 MHz. The same radar frequency would also be advantageous for the meteor and auroral investigations. In view of their significance in field-aligned ionization studies, the transverse propagation angle contours have been computed at specified latitudes along a given meridian. These contours are used to predict the radar beam orientations for which certain field-aligned phenomena might be observed. Author (TAB)

N67-32903# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
DETECTABILITY OF RECURRENCE PHENOMENA
Loren W. Molte and David Jaarsma May 1967 210 p refs
(Contract Nonr-1224(36))
(Rept.-3674-11-T; TR-179; AD-652383) CFSTI: HC $3.00/MF $0.65

The report investigates the detectability of a broad class of signals that occur in active sonar, passive sonar, and active radar. The signals investigated are detectable at low signal-to-noise ratio because they are composed of repeating waveforms. The purpose of the report is to further the theory of signal detectability for underwater acoustics by determining the detection performance for optimum receivers for various signals and signal-to-noise conditions. The work deals with a mathematical model of the signals and the noise. It is not an analysis directed at any existing detection system. For practical situations which are approximately those of the models the work yields an approximate upper bound on the detection performance that can be achieved. The specific cases of recurrent-transient signals in white Gaussian noise considered are: (1) M orthogonal waveforms, periodic recurrence, (2) M orthogonal waveforms, synchronous-Poisson recurrence, and (3) sporadic recurrent waveforms of known waveshape. These cases are important in passive sonar because they describe situations which have a wide range of waveform uncertainty as well as recurrence-time uncertainty. Author (TAB)

N67-32918# Air Force Cambridge Research Labs., Bedford, Mass.
AN EXPERIMENTAL STUDY OF PLASMA-COVERED SLOTS ON CYLINDERS AND CONES
Nicholas V. Karas and John D. Antonucci Apr. 1967 30 p refs *Its* Phys. Sci. Res. Papers No. 314
(AFCRL-67-0132; AD-652208) CFSTI: HC $3.00/MF $0.65

The effect of a plasma on the radiation characteristics of slot and gap apertures located on structures such as cylinders and cones has been studied by means of a plasma simulation technique. The relative index of refraction of less than unity between plasma and free space was maintained for the model by an analog tank that represented free space by a high dielectric constant liquid and the plasma by a lower dielectric material. This technique differs from a previous simulation method in that the models can be immersed into the tank, rather than being kept external. This modification allows the study of nonplanar geometries of complex shapes. Antenna patterns of axial slots on cylinders of various radii and thicknesses of plasma covering were observed to have good agreement with theory for radiation in the equatorial plane, as did the antenna patterns for a plasma-covered center-fed cylindrical antenna. Experimental patterns of a slot on a cylinder partially covered by a plasma are presented. Various effects of the plasma on the radiation characteristics of the slot were observed by varying the location of the plasma on the cylinder in relation to the slot and by varying the amount of surface area covered by the plasma. Experimental patterns of slots on cones covered by a plasma are also presented. Author (TAB)

N67-32962 Helber Research and Development Corp., Tempe, Ariz.
STUDY AND INVESTIGATION OF A TECHNIQUE FOR EVALUATING SURVEILLANCE SENSOR PERFORMANCE Final Report Jul.–Nov. 1966
J. D. Patterson and G. L. Edson Apr. 1967 37 p refs
(Contract DA-02-086-AMC-0549(R))
(USAEPG-FR-299; AD-652109) CFSTI: HC $3.00/MF $0.65

Investigations and studies have been performed to determine the feasibility of a technique for evaluating the performance of surveillance mapping sensors. The case of the airborne mapping radar is specifically considered. The evaluation technique described is based on the use of the cross-correlation function between a replica of a controlled target array and the radar output film. The requirements for the target array are analyzed and a method for fabricating the required reference replicas is discussed. Methods for implementing the cross-correlation process are presented; the noncoherent optical correlator is suggested as the most feasible implementation. Conclusions supporting the feasibility of the technique are given followed by recommendations for further development of the evaluation technique. TAB

N67-32955# Air Force Cambridge Research Labs., Bedford, Mass.
A LINE-SOURCE CORRECTOR FOR LARGE SPHERICAL REFLECTORS

Nicholas P. Kernweis and Frederick H. Cleveland Mar. 1967 25 p refs *Its* Physical Sci. Res. Paper No. 315
(AFCRL-67-0142; AD-652202) CFSTI: HC$3.00/MF$0.65

Theoretical and experimental results demonstrating an increase in effective aperture area of a spherical reflector are presented. The correcting device described in this paper is a line source used in conjunction with a horn. Author (TAB)

N67-32956# Northwestern Univ., Evanston, Ill. Information-Processing and Control Systems Lab.
GRAPH THEORETIC ERROR-CORRECTING CODES
S. L. Hakimi and J. G. Bredeson Jun. 1967 49 p refs
(Contract N00014-67-A-0356-0003; Grant AF-AFOSR-98-65)
(TR-67-110; AD-652604) CFSTI: HC$3.00/MF$0.65

The paper presents a study of graph theoretic block codes, their efficiency, their capabilities, and their limitations. Augmentation of graph theoretic codes and their generation are discussed. It is shown that such augmentation techniques often can increase the level of efficiency of these codes to that of the best available codes. Furthermore, the augmented graph theoretic codes are shown to be easily decodable. The same ideas are applied to the directed graphs resulting in a class of easily decodable ternary codes. TAB

N67-32962 Stanford Research Inst., Menlo Park, Calif.
ATMOSPHERIC RADIO NOISE DATA, BANKOK, THAILAND, JUNE–AUGUST 1966
Rangsit Chindahporn, Chaikamol Lumjiak, and Prajuab Nimityongskul Jan. 1967 20 p
(Contract DA-36-039-AMC-00040(E); ARPA Order-371)
(SRI-4240; AD-652685) CFSTI: HC$3.00/MF$0.65

Contents: ARN-3 Atmospheric Radio Noise Measuring Equipment; Location of the Radio Noise Recording Station at Laem Chabang, Thailand; Radio Noise Recording Station; Nomogram for Transforming Effective Antenna Noise Figure to Noise Field Strength as a Function of Frequency; Three-Month Median Time-Block Values of Radio Noise Power. Author (TAB)

N67-32978# Army Electronic Proving Ground, Fort Huachuca, Ariz. Atmospheric Sciences Lab.
RADAR ANGELS AND ATMOSPHERIC CONVECTION IN ARIZONA
Arthur V. Carlson Mar. 1967 37 p refs
(ECOM-6025; AD-653014) CFSTI: HC$3.00/MF$0.65

Anomalous clear atmosphere returns of X-Band vertically pointing radar signals observed at Fort Huachuca, Arizona, during September - October 1964, are examined in conjunction with analysis of low level atmospheric convection. It is concluded that the radar echoes, commonly termed dot angels were produced by sharp gradients in refractive index across the boundary surfaces of convective air parcels. Author (TAB)

N67-32982# Paris Univ. (France).
THE JOINT SATELLITE STUDIES GROUP
Oct. 1966 157 p refs
(Grant AF-EOAR-66-54)
(JSSG-2; AFCRL-66-859; AD-647797) CFSTI: HC $3.00/MF $0.65

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5. REFRACTION p 109–116 (See N67-32987 19-07)
6. EQUIPMENT p 117–139 refs (See N67-32988 19-07)
7. FUTURE PLANS p 140–153 (See N67-32989 19-07)

N67-32983# Paris Univ. (France).
OBSERVATORIES REPORTS
In its The Joint Satellite Studies Group Oct. 1966 p 2–16 refs (See N67-32982 19-07)

Reviewed are research activities of several observatories engaged in ionospheric propagation studies through satellite transmissions. Presented are reports from the United States, Norway, France, Germany, Sweden, Greece, Italy, Denmark, Turkey, Kenya, Ghana, and Israel. S.C.W.

N67-32984# Paris Univ. (France).
TOTAL ELECTRON CONTENT COMPUTATION
In its The Joint Satellite Studies Group Oct. 1966 p 17–49 refs (See N67-32982 19-07)

Reported are individual papers on a hand analysis method for computing total electron content from two frequency Faraday rotation; a computer program for computing total electron content from two frequency Faraday rotation; a programmed Faraday total electron content at two near frequencies; a computational procedure for single frequency Faraday rotation; and error analysis in total electron content using the differential Faraday method. S.C.W.

N67-32986# Paris Univ. (France).
SCINTILLATION STUDIES
In its The Joint Satellite Studies Group Oct. 1966 p 93–108 refs (See N67-32982 19-07)

Reported are a series of papers on the measurement and comparison of scintillation index values; 136 MHz Early Bird scintillations summer 1965 observations; a diurnal and seasonal analysis of scintillations of Transit 4 A; and October to November 1964 S-66 scintillation results in Florence. S.C.W.

N67-32987# Paris Univ. (France).
REFRACTION
In its The Joint Satellite Studies Group Oct. 1966 p 109–116 (See N67-32982 19-07)

A method is proposed which demonstrates the significance of the refractive term in the differential Doppler and Faraday effects in relation to the term originated from the total electron content. To illustrate the effectiveness of the method, results from a reckoning performed for the rotation 5267 of the Explorer 27 satellite are included. S.C.W.

N67-32988# Paris Univ. (France).
EQUIPMENT
In its The Joint Satellite Studies Group Oct. 1966 p 117–139 refs (See N67-32982 19-07)

Reported are a series of papers on equipment engineering for satellite observation and experiment; a test rig for digital measurement of Faraday zero time intervals; ground equipment for ionospheric research; a phase locked system applicable to the receiver's if output; and a pulse code modulation (PCM) telemetry system. S.C.W.

N67-32989# Paris Univ. (France).
FUTURE PLANS
In its The Joint Satellite Studies Group Oct. 1966 p 140–153 (See N67-32982 19-07)

Reported are plans for future studies which focus on the prediction of joint satellite observations; and the San Marco B satellite ionospheric experiment. S.C.W.

N67-33007# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUIPMENT ON SEMICONDUCTORS AND METHODS OF RADIO WAVE MAPPING [APPARATURA NA POLUPROVODNIKAKH I METODIKA RADIOVOLNOVOGO KARTIROVANIYA]
A. D. Frolov 17 Mar. 1967 28 p refs Transl. into ENGLISH from Tr. Mezhvuzovskoy Konf. po Induktivnym Metodam Rudnoy Geofiziki (Moscow), 1964 p 190–202
(FTD-MT-65-369; TT-67-62013; AD-652468) CFSTI: HC $3.00/MF $0.65

The practical value and promising outlook of using radio wave mapping for geological surveys is quite apparent and the necessity of introducing this method is obvious. The PINP-1 and PINP-1M semiconductor field intensity meters are used for this purpose. The latest version of this meter, the PINP-2, is examined. The conditions under which these meters operate are considered and details are given on their performance. Author (TAB)

N67-33013*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PCM TELEMETRY DATA COMPRESSION STUDY, PHASE II Quarterly Report, 25 Nov. 1965–25 Feb. 1966
W. R. Bechtold, T. Bjorn, Jr., and J. E. Medlin Apr. 1966 91 p refs
(Contract NAS5-9729)
(NASA-CR-86993; LMSC-M-62-66-2; QR-2) CFSTI: HC $3.00/MF $0.65

The study seeks to improve the efficiency of NASA/GSFC pulse code modulation (PCM) telemetry links through data compression. The present part of the study centers on the effect of transmission link noise on compressed data. A compression model analysis was performed using telemetry data from the S-49, OGO-A satellite, and an exploratory multisensor compression and buffer simulation run was made on 184,000 input data samples. New data compression models that were evaluated by computer simulation included sample selectors and buffer feedback for queuing control. Four computer programs were written for new or modified sample selection techniques. Since an earlier study of buffer queuing control had shown that a combination of the queue length and its time integral promises to be an effective parameter to control data tolerance, a system using this parameter was programmed for computer evaluation. Computer programs were also completed for simulation of ground transmission link noise effects on compressed data. K.W.

N67-33026 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMMUNICATIONS NETWORKS. PART I: REVIEW OF SOVIET LITERATURE. PART II: DESIGNATIONS AND ABBREVIATIONS Surveys of Foreign Scientific and Technical Literature
Wladimir Podpaly 16 Jan. 1967 60 p refs
(ATD-67-5, Pt. I-II; AD-649721)

CONTENTS:
1. COMMUNICATIONS EQUIPMENT p 1–38 (See N67-33027 19-07)
2. COMMUNICATIONS FACILITIES AND THEIR LOCATION p 39–51 (See N67-33028 19-07)

N67-33027 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMMUNICATIONS EQUIPMENT
In its Commun. Networks Pt. I: Rev. of Soviet Lit. Pt. II: Designations and Abbreviations 16 Jan. 1967 p 1–38 (See N67-33026 19-07)

Abstracts of 12 articles are presented which are concerned with recent developments in Soviet communications equipment. The abstracts are based on Soviet open sources published mainly in 1965–1966. The following types of equipment are covered: (1) three types of new drop and connecting communication cables; (2) a Czech-made carrier telephone system for rural areas, and a central one-way calling system to local-line home telephones; (3) a description of the German-made T-51, T-63, and the Soviet ST-35 teletypewriters; (4) Soviet intercity facsimile equipment; and (5) a telegraph signal distortion meter. Of two titles dealing with radio relay systems, one describes the modernization of the Hungarian RM-24 system for railroads, the other describes a horn-parabolic antenna for combined operation in two systems. Two other articles cover long-distance voice frequency railroad calling equipment and a portable transistorized transceiver for use on trains. A miniature transceiver for glider planes and a receiver for parachutists are the subject of another article. K.W.

N67-33028 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMMUNICATIONS FACILITIES AND THEIR LOCATION
In its Commun. Networks. Pt. I: Rev. of Soviet Lit. Pt. II: Designations and Abbreviations 16 Jan. 1967 p 39–51 (See N67-33026 19-07)

The 11 abstracts presented here deal with several types of communications facilities located in certain regions of the U.S.S.R. The abstracts are based on Soviet open sources published mainly in 1965–1966. The following subjects are treated: (1) a two-cable multiplexed telecommunication facility for railroad lines; (2) three articles on reliability of railroad radio relay communications; (3) recent development in radio, cable, television, and telephone systems in the U.S.S.R.; (4) radio relay systems over the T'ien-shan mountain range and between Moscow and Ryazan; (5) the telegraph networks of the Soviet railroad system; (6) long-distance telephone service in Moscow; (7) cable installation during the past 25 years by the Soviet Trust for Construction of Railroad Communication Facilities; and (8) modernization of telecommunication facilities of the Moscow–Siberia–Central Asia railroad line. K.W.

N67-33083*# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
INVESTIGATION IN AND RESEARCH OF AEROSPACE RELATED MICROWAVE TECHNOLOGY Final Report, 1 Jan. 1965–31 Oct. 1966
E. J. Denlinger et al 28 Feb. 1967 533 p refs
(Grant NGR-39-010-030)
(NASA-CR-87055; Rept.-67-20) CSCL 20N

A state of the art review is presented on the technology related to aerospace applications of millimeter and submillimeter waves. Topics covered include generation, detection, transmission, propagation, modulation, environment, antennas, measurements, radio interference, and radiation hazards. Research recommendations are classified according to technical areas and their potential for useful results. Detailed assessments are presented on the status of materials; electron beam type generators; quantum generators and amplifiers; modulation; transmission lines and components; propagation of the spectrum of air absorption using coherent sources; superheterodyne and homodyne detection, and detector devices; and phased arrays. Charts are provided as an aid to estimating the capability of point-to-point communication systems, radar, and radiometry. An extensive reference bibliography is included. M.G.J.

N67-33091# Raytheon Co., Alexandria, Va. Autometric Operation.
GEOSCIENCE POTENTIALS OF SIDE-LOOKING RADAR, VOLUME I
F. D. Beatty, A. D. Beccasio, E. S. Becker, R. A. Bradie, R. F. Holmes et al 1967 101 p refs
(Contract DA-44-009-AMC-1040(X))
(AD-650498) CFSTI: HC $3.00/MF $0.65

A study was made to present a fair evaluation of the SLAR systems utility in geoscientific investigation. The series of products produced in this work permit a demonstration of the level of applicability of the system to terrestrial studies through exploitation of the systems inherent advantages of broad areal coverage, all-weather day/night operation, and economy and rapidity of data extraction. Many of these advantages can be readily extrapolated for use in our first tentative steps in the exploration of the lunar and planetary surfaces of our universe. Author (TAB)

N67-33138*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL TECHNIQUES FOR OBSERVING MOTION OF EXTENDIBLE ANTENNA BOOMS
Donald J. Hershfeld *In* NRL Shock and Vibration Bull., No. 38, Pt. 6 Feb. 1967 p 195-202 ref (See N67-33122 19-32) CSCL 09F

Experimental techniques, developed for the damping tests of 23- to 43-ft long segments of the 750-ft long extendible antenna booms used on the Radio Astronomy Explorer (RAE) satellite, are described. The booms, which are stored as a flat tape on a spool in the spacecraft and then assume a tubular shape when deployed, are extremely flexible in long lengths. These tests were conducted by suspending segments of the boom as vertical cantilevers in a vacuum and measuring the decay rate of amplitude when the boom was released from an initially deflected configuration. Two methods were used to observe the motion: a photographic method in which time exposures of the boom tip were recorded on film, and a strain gauge transducer, which measured bending moments in two directions at the root end of the boom. The output signals from the strain gauge transducer, when displayed on an X-Y plot, described interesting Lissajous patterns which essentially duplicate the path traced out by the free end of the boom. These patterns are interpreted by a mathematical model of the boom, programmed on an analog computer. Author

N67-33182# Syracuse Univ. Research Inst., N. Y. Electrical Engineering Dept.
ANALYSIS AND SYNTHESIS OF UNEQUALLY SPACED ARRAYS USING THE Z-TRANSFORM
Marc I. Spellman and Bradley J. Strait 15 Apr. 1967 13 p refs
(Contract AF 19(628)-5882)
(AFCRL-67-0230; SR-3; AD-651433) CFSTI: HC $3.00/MF $0.65

It is shown that under certain conditions, Z-transform theory can be applied to simplify analysis and synthesis of unequally spaced antenna arrays. The approach provides significant advantages over other techniques since the method yields closed-form expressions for array factors that are otherwise often cumbersome and difficult to work with analytically. The method is useful for both broadside and endfire arrays and allows many of the results originally derived for equally spaced arrays to be applied. Author (TAB)

N67-33199*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POSITION LOCATION AND AIRCRAFT COMMUNICATION EQUIPMENT (PLACE)
Charles R. Laughlin, Roger C. Hollenbaugh, Erwin Hirschmann, and Walter K. Allen Apr. 1967 130 p
(NASA-TM-X-55862; X-731-67-159) CFSTI: HC $3.00/MF $0.65 CSCL 09F

An overall system concept is described which would provide two-way voice and digital data communications between all cooperating aircraft and their associated ground control facilities by means of a transponder aboard a single geosynchronous satellite. Real time surveillance would be provided through continuous position tracking and automatic reporting from telemetry sensors onboard the aircraft. The principle elements of the PLACE (position location and aircraft communication equipment) communication system are the primary control center, one or more alternate control centers, the synchronous satellite, and the cooperating aircraft in the coverage area. The position-location system uses a rho-rho technique whereby the position of the aircraft is defined by the intersection of three spheres. A satellite inertial navigation determination (SIND) subsystem has been incorporated into the PLACE design to increase overall reliability. Performance analyses data are included. M.G.J.

N67-33205# Army Missile Command, Huntsville, Ala. Radar Branch.
A NEW CLUTTER MODEL WHICH ACCOUNTS FOR CLUTTER CORRELATION AND ITS APPLICATION TO RADAR DESIGN
Robert C. Ward 1 Jun. 1967 143 p refs
(RE-TR-67-1; AD-654137) CFSTI: HC $3.00/MF $0.65

The report analyzes current radar clutter models and examines the criteria by which they are applied in the prediction of radar clutter performance. The fundamentals of radar detection theory are reviewed in order to devise a more appropriate clutter model. The principal criterion in current use, the average probability of clutter false alarm, is not always adequate in predicting radar clutter performance. Furthermore, the generally accepted methods of determining the average probability of clutter false alarm can be improved. A new clutter model is synthesized, from the current average-probability-of-clutter-false-alarm criterion (properly calculated), and from new, more relevant criteria based on the detection and tracking performance of a radar system. The spatial correlation of large radar clutter returns determines the probability that clutter false alarms will occur in adjacent clutter patches, creating 'dark zones' which preclude target detection. The size and shape of the dark zone will also determine whether tracking can be performed. The probabilities of various classes of dark zones versus the value of radar reflection coefficient which will cause a clutter false alarm are determined from empirical clutter data, and are used to illustrate a new clutter model application. Author (TAB)

N67-33262*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
STUDY OF NONSTATIONARY RANDOM PROCESS THEORY Final Report, 1 Jul. 1966-30 Apr. 1967
Walter W. Wierwille and James R. Knight Jun. 1967 63 p refs
(Contract NAS8-11346; Proj. Etude III)
(NASA-CR-87289; CAL-XM-1970-B-3) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Methods for analyzing nonstationary processes in nonreal-time (computer-time) applications are considered. A theory for non-real-time correlation analysis and a theory for nonreal-time spectrum analysis are presented. These theories do not require that the assumptions of stationarity and ergodicity be made or even approximated. Instead, the theories are based on approximation of the expectation definition of the correlation function or its Fourier transform. Accordingly, correlation functions and spectra containing running-time axes may be postulated legitimately. The theories make use of test functions for optimization of the analyzer configurations. Finally, an experimental verification of the correlation theory is presented. Digital programs and plotting routines were used to obtain nonstationary correlation function estimates for data with known correlation functions, thereby making possible an

analysis of estimation errors. In addition, a nonstationary correlation function estimate was obtained for flexible booster vibration data. This analysis shows the feasibility of the nonstationary theory. Author

N67-33269# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RADAR WARNING SYSTEM

Yin Jui 14 Mar. 1967 11 p Transl. into ENGLISH from Hang Kiung Chih Shih, no. 12, 1964 p 9–11

(FTD-HT-66-164; AD-653503) CFSTI: HC $3.00/MF $0.65

Since the rapid development of the electronics industry after World War II, radar has been used to perform various missions in the Air-Defense System. For low speed aircraft, radar systems can be divided into early warning radar, ground fire-control radar, etc. Today, however, the speed of aerial attacks is greatly increased in ballistic missiles and supersonic aircraft. The time allowed to compute defense data is therefore greatly reduced, and the old defense systems are no longer capable of handling a high-speed air attack. For meeting the challenge of ICBM attack, the defense system must be modified. One approach is to increase the effective radar distance, and to automate the calculation of all data and its delivery to the defensive missile site. Newly developed radar units such as ground-to-air missile-guiding radar, air-to-air missile-guiding radar, and guided missile search radar have been extensively developed. The author points out, in conclusion, that an air defense system must be constantly changing to meet the requirements of newly developed techniques of aviation. Author (TAB)

N67-33270*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN EFFICIENT CODING SYSTEM FOR DEEP SPACE PROBES WITH SPECIFIC APPLICATION TO PIONEER MISSIONS

Dale R. Lumb and Larry B. Hofman Washington, NASA, Aug. 1967 42 p refs

(NASA-TN-D-4105) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Rate 1/2 convolutional encoding with sequential decoding has been investigated for application to deep space probe telemetry links which are characterized by a gaussian channel with coherent matched filter detection of phase shift keyed signals. A (50, 25) code was optimized and its performance evaluated by means of computer simulations. Data for these studies were organized into blocks of 224 information bits where 14 bits were known at the end of each block for purposes of synchronization and to aid in decoding. Results show that the basic coding technique yields a gain of at least 6.5 dB over no coding. For error detection, a technique of reverse decoding was investigated. This technique, used in conjunction with extending the known sequence at the end of each block to 21 bits, permits an additional 0.9-dB gain. The implementation of this coding scheme on Pioneer missions is considered. Since Pioneer is an operational program, the mission-dependent equipment is analyzed to determine the modifications required for introducing error correction coding to a no-coded telemetry link. Author

N67-33273# Denver Research Inst., Colo.

RESEARCH ON NEW TYPES OF ANTENNA SYSTEMS FOR THE FREQUENCY RANGE 450–1150 MC Final Research Report, 4 Jun. 1965–5 Jun. 1966

Warren R. Wheeler and Kent L. Schepler 17 Nov. 1966 35 p (Contract NOw-65-0318-d)

(RR-2; AD-652099) CFSTI: HC $3.00/MF $0.65

The report describes a log-periodic half loop antenna. The antenna, which works against a ground plane, evolved from a log-periodic full loop antenna. The physical configuration of the half loop antenna lends itself particularly well to use on aircraft. Far field patterns and impedance data for the various models constructed are presented. Author (TAB)

N67-33296# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LIMITING INFORMATION CONTENT OF TELEVISION SIGNAL

Chou Chiung-pan 25 Jan. 1967 28 p refs Transl. into ENGLISH from Tien Tzuhsueh Pao, no. 4, 1964 p 24–39

(FTD-HT-55-592; AD-653529) CFSTI: HC $3.00/MF $0.65

The author discusses the bandwidth compression and limiting information content of television (TV) signals. Equation is used to determine the information content of stereophonic signals, remote control signals, telemetering signals, and monochrome TV signals. As indicated the necessary TV channel bandwidth can be compressed 4 times by pseudorandom scanning, 2 times by elimination of interferences between scanning lines, and 28 times by adoption of sweeps having a variable duration. The max bandwidth compression ratio for monochrome TV signals is 320–520. The limiting information content of color TV signals can be estimated roughly. The channel bandwidth of color TV signals can be compressed by improving the random vector field structure. The bandwidth of stereo-TV signals is compressed by eliminating the interferences between pictures. The author urges that extensive studies must be made on mathematical theories to solve the information content problems, on TV signal characteristics and visual sensation of human eyes, and on the practical use of bandwidth compression methods. Author (TAB)

N67-33354*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

METHOD OF COMPUTING SYSTEM TRACKING MARGINS

Fred W. Kallmeyer Mar. 1967 18 p refs

(NASA-TM-X-55861; X-553-67-154) CSCL 17I

Described is a mathematical computational procedure that can be used to determine the signal level as a function of time for any particular communication or tracking system. Nominal values are assumed for equipment operating characteristics and the range equation is used for free space attenuation. Presented is a fundamental discussion of the need for system tracking margin determination which includes a block diagram of the overall system tracking margin determination. The aspect angles theta and phi are defined with respect to the spacecraft axes and the spacecraft tracking station line-of-sight, and the coordinate systems and transformations necessary to determine the aspect angles are described. Euler angle rotations are used to describe the transformations between coordinate systems. The nominal system characteristics for the unified S-band and C-band communications and tracking are presented, and the equations for determining the signal levels are developed. Author

N67-33368*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

RADAR SCATTERING FROM THE SEA

G. R. Valenzuela and E. B. Dobson *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Stereo ocean profiles of height versus distance are presented for rough sea conditions, and the energy wave spectrum obtained for high frequencies compares favorably with the Phillips asymptote in the frequency domain. This spectrum was obtained for one profile of 596 height points spaced 0.315 inch apart for rough sea conditions; and using a Fourier series fit, up to the fifth harmonic was removed in the length of the profile. The behavior of the autocorrelation function from the stereophoto versus lag distance is plotted. M.W.R.

N67-33381*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

WIDEBAND ARRAY ANTENNA SYSTEM

E. V. Byron *In its* Res. and Develop. Programs Mar. 1967 1 p (See N67-33361 19-34)

Distortion of the radiation pattern of a 96-element phased array was investigated with a matching dielectric sheet at each face of the phase-shifter matrix; and in the frequency band where the sheet presented a reasonable match, the radiation patterns were improved. Phase shifters with a lower magnetic saturation material improved low frequency response by approximately 500 Mc/s and permitted operation from 3 to 12 kMc/s. The impedance of a simulated infinite array of triangularly spaced elements was measured; and a wideband impedance match using a double-step dielectric impedance transformer was studied, including optimization to cover the full-frequency band and other matching schemes. M.W.R.

N67-33387*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

RADAR CHARACTERISTICS OF KNOWN, SINGLE BIRDS IN FLIGHT

T. G. Konrad, J. J. Hicks, and E. B. Dobson *In its* Res. and Develop. Programs Mar. 1967 2 p ref Sponsored in part by AFCRL (See N67-33361 19-34)

Radar return from single birds in flight is characteristically different from other possible sources of point or dot target returns from aircraft, swarms of insects, several birds together, small clouds, or meteorological structures. No recognizable wavelength dependence to radar cross sections is found, since the birds fall into the Mie or resonant region. The radar return does, however, contain a signature that is composed of a log-normally distributed radar cross section, and the characterizing parameter is the mean-to-median ratio of cross section that represents a measure of amount of fluctuation in the returned signal. This ratio is a function of the size of the bird relative to the radar wavelength. The energy spectrum of the signature contains peaks that indicate periodic, relative motion within the bird's wingbeat. M.W.R.

N67-33391*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

PHASED-ARRAY ANTENNA SYSTEM

J. Frank *In its* Res. and Develop. Programs Mar. 1967 2 p Sponsored in part by ARPA (See N67-33361 19-34)

Measurements were made of a C-band phased-array antenna system with its eight subarrays arranged in three different geometries, namely aligned in the E-plane, aligned in the H-plane, and arranged to approximate circular aperture. Gain of a uniformly illuminated array measured at boresight was 20.1 db. The voltage standing-wave ratio of a subarray immersed in an array of radiating subarrays had a peak value of 2.1 db. Pointing errors were found to be too small to permit an accounting for the source of errors, and maximum absolute pointing error of the array was 1/50 beamwidth. Antenna patterns indicate good predictable performance in all modes of operation, and there was no evidence of lost beams. The near-theoretical boresight pattern for subarrays aligned in the H-plane is shown with the sin x/x theoretical envelope superimposed. The phased array is being used in the study of effects of different phase-computation techniques to support grating lobes that result from the digital nature of the phase shifter. M.W.R.

N67-33407*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PSK SUBCARRIER DEMODULATORS FOR DATA ACQUISITION

V. J. Di Losa, V. R. Simes, and T. V. Saliga Apr. 1967 16 p refs

(NASA-TM-X-55866; X-523-67-214) CFSTI: HC $3.00/MF $0.65 CSCL 09F

This report analyzes and discusses the use of phase shift keying (PSK) subcarrier demodulators to overcome the SNR degradation and filtering errors associated with signal conditioners now being used as demodulators for low data rate PCM/PSK. It is shown that a PSK subcarrier demodulator provides very close to ideal performance. The signal conditioners, which were not designed for the subcarrier demodulation function, are deficient in the following areas: 1) improper filtering of the signal prior to squaring for subcarrier regeneration; 2) low sensitivity of phase lock loop; and, 3) filtering matched to the subcarrier rate rather than the data rate. Because the envisioned PSK demodulator can be optimized for these functions it will provide about 10 db more sensitivity at threshold than now being achieved. Author

N67-33486*# Technische Hochschule Munchen (West Germany). Institut fur Hochfrequenztechnik.

ANTENNA RESEARCH Scientific Report, 1 May 1966–31 Jan. 1967

H. H. Meinke 1 Feb. 1966 94 p

(Contract AF 61(052)-950)

(SR-1; AD-648850) CFSTI: HC $3.00/MF $0.65

A study was made of electrically small antennas with top capacity and a transistor circuit between the top capacity and the main rod of the radiator. We find broadband characteristics, semi-directivity, good matching to standard output cables and the possibility to vary the antenna characteristics by changing the bias of the transistors were found. The noise of such antennas was measured. Extended measurements were made on plane Archimedean spiral antennas to improve the knowledge of antenna currents and nearfield. Measurements on the backing cavity resonances led to the development of lossy foils to avoid unwanted resonances within the cavity. It was demonstrated that lossy foils improved the radiation patterns and the broadband matching of the input impedance at the resonance frequencies of the cavity. Author (TAB)

N67-33478*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN QUESTIONS OF AUTOMATIC IDENTIFICATION OF SPEECH SIGNALS AND CONTROL OF MACHINES WITH THE USE OF SPEECH

A. G. Kakauridze *In its* Acad. of Sci. of the Georgian SSR Inst. of Electron. Automation and Remote Control 20 Mar. 1967 p 1–37 refs (See N67-33177 19-08)

Various possible applications of automatic recognition of speech signals by machines (automatic voice operated equipment) are listed. The manner in which various speech sounds are produced by the human vocal organs, the various attempts to classify voice sounds in accordance with absolute attributes on the basis of which speed-recognition machinery could be built, and the paths followed by various researchers to find objective criteria for automatic speech-sound recognition are reviewed. These include studies of conditions under which speech sounds are articulated by humans, artificial synthesis of speech sounds, and investigations of the physical characteristics and properties of the speech sounds themselves, particularly spectral analysis of speech and studies of clipped speech. The use of computers for analysis and recognition of speech is believed by the authors to be most promising. A table appended to the article contains brief information on the main characteristics of experimental apparatus for recognition and differentiation of speech signals, including the experimental apparatus for automatic word recognition. Author

N67-33489# Stanford Univ., Calif.
FULL-SCALE PATTERN MEASUREMENTS OF SIMPLE HF FIELD ANTENNAS IN A U.S. CONIFER FOREST
William A. Ray, Gary E. Barker, and Sandra S. Martensen Feb. 1967 200 p refs *Its* Special Tech. Rept. 25
(Contract DA-36-039-AMC-00040(E); ARPA Order 371)
(AD-653165) CFSTI: HC $3.00/MF $0.65

During May and June of 1965, measurements of field-expedient antenna impedance and radiation patterns were conducted in a conifer forest. The antennas measured included dipoles, slant wires, and inverted Ls. The pattern measurements were conducted with an aircraft-towed transmitter. The results are presented on contour maps showing individual polarization response for elevation angles from 5 to 60 from the horizon and power response from 5 above the horizon to the zenith for several frequencies between 2 and 15 Mc/s. Input impedances are presented on Smith charts for each antenna over the frequency range that the above pattern data are presented. In addition, curves of resonant frequency and input impedance as a function of antenna height are presented for selected dipoles. The results demonstrate that the trees surrounding the antennas begin to cause perturbations to the vertical polarization response of antennas at approximately 8 Mc/s. Author (TAB)

N67-33505# California Univ., Livermore. Lawrence Radiation Lab.
AN INTRODUCTION TO THE THEORY OF SIGNAL-TO-NOISE ENHANCEMENT
Thomas A. Brubaker 5 Jan. 1967 28 p refs
(Contract W-7405-ENG-48)
(UCRL-50171) CFSTI: HC $3.00/MF $0.65

The fundamental methods of statistical analysis used to recover signals from noise are presented. Emphasis is on simple time- and sample-averaging techniques. Three primary methods of signal-to-noise enhancement are considered: filtering, integration, and averaging of repeated samples. References to the basic literature are included. Author (NSA)

N67-33531# Airtron, Inc., Morris Plains, N. J.
DUPLEXER FOR SIDE-LOOKING RADAR Final Report, 1 Oct. 1964–30 Dec. 1966
M. King and B. Maher Apr. 1967 72 p refs
(Contract DA-28-043-AMC-00280(E))
(RII-529; ECOM-00280-F; AD-653781) CFSTI: HC $3.00/MF $0.65

The report describes the research and development directed towards advancing the state of the art in the field of microwave duplexers intended for application in a side-looking radar. A three port junction circulator was developed capable of operating at a peak power level of 300 kw. Many ferrite materials were evaluated for use in this device. Single crystal yttrium iron garnet was employed as a power sensitive element in a completely solid state limiting device. Ferrite materials investigated during this program did not wholly possess both the peak power and remanent characteristics for use in the latching four port switch. Author (TAB)

N67-33561 Joint Publications Research Service, Washington, D. C.
PRINCIPLES OF PREDICTING IONOSPHERIC AND MAGNETIC DISTURBANCES AND SHORT-RANGE RADIO PROPAGATION PREDICTION SERVICES. A MANUAL
R. A. Zavakina, Ye. V. Lavrova, and L. N. Lyakhova 17 July 1967 111 p refs Transl. into ENGLISH of the book "Osnovy Prognozirovaniya Ionosferno-Magnitnykh Vozmushcheniy i Sluzhba Kratkosrochnykh Radioprognozov. Rukovodstvo" Moscow, Izd. Nauka, 1967 p 1–77
(JPRS-41851; TT-67-32483) CFSTI: $3.00

The basic disturbances of ionospheric disturbances are described, and information on the possible causes of these disturbances is presented. Also described are the impairments of radio communication occurring during disturbances, and a method for short-range prediction of ionospheric–magnetic disturbances. Explanations are given on how to use predictions and current information on the state of the ionosphere for practical computations, and examples of these calculations are presented. C.T.C.

N67-33594* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SPEECH COMMUNICATIONS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 1–4 *ref* (See N67-33594 19-10)
(Contract AF 19(628)-5051)

Abstracted data are presented on linguistic factors in the perception of time distorted speech. Experimental results show that when alternation of speech patterns was related to syllables, errors in shadowing were twice as frequent as when alternation was periodic at Huggins' critical rate. These findings indicate that syllabic structure of the speech signal cannot be time altered without serious consequences to perception, and that distortion of other linguistic units may prove to be equally disturbing. Experimental results of a separate study of a long-duration inhibitory process in the cerebral cortex indicate that the pathway responsible for information transfer from the stimulated to the recording sites is almost exclusively in the most superficial or molecular layer of the cortex. R.L.I.

N67-33605* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SCATTERING OF ELECTROMAGNETIC WAVES BY SOLID OBJECTS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 106–116 refs (See N67-33605 19-10)
(Contract AF 19(628)-1691)

Progress is reported for electromagnetic field research in the scattering of electromagnetic waves by solid objects. Problem areas studied were: resonance region scattering, scattering by a finite cone, general scattering from a finite cone, bi-conical antenna scattering by a hemisphere, general scattering from the finite circular cylinder, and modification of the back scattering cross-section of a metal cylinder by impedance loading. R.L.I.

N67-33606* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
PROPAGATION OF A LIGHT BEAM IN A RANDOM MEDIUM
F. V. Schultz and T. J. Gilmartin *In its* [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 117–118 refs (See N67-33593 19-10)

For application to communication and telemetry systems using the atmosphere as a transmitting medium, research was undertaken on the propagation of a light beam in a random medium. Significant statistical properties of the turbulent medium and those of the received signal are calculated as a function of position in the transverse receiving plane. Project work is directed toward determining: the intensity profile of the beam at some distance into the perturbed medium, the statistical properties of the amplitude phase and intensity fluctuations of the received signal, and the spectrum of phase and intensity fluctuations in the practical case described above. R.L.I.

N67-33609* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SIGNAL DESIGN

In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 143–145 refs (See N67-33593 19-10)
(Grant NsG-553)

Advancements in communication signal design are very briefly reported for selected topics. M-Ary signal sets for scatter-multipath and other asynchronous communication are outlined, while abstracted data on adaptive modulation of signals for a Rayleigh fading medium is sketched. R.U.

N67-33610* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ADDITIONAL COMMUNICATION SCIENCES RESEARCH AREAS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 146–163 refs (See N67-33593 19-10)
(Grants NsG-553; NGR-15-115-021; NsG-543; NSF GK-189)

For possible utilization in electronic communication systems, some additional communication science research, particularly on phase–lock loop studies is developed. Some abstracted data are presented on: correlation detectors, performance of self bit synchronizing systems, digital simulation of a randomly time–variant communication channel, signal deblurring, theory of random process, phase–lock loop studies, high-order phase–locked loop behavior in the presence of white noise, random signal radar, and estimation of sonar target parameters. R.U.

N67-33640# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
TRANSMISSION LOSS PREDICTIONS FOR TROPOSPHERIC COMMUNICATION CIRCUITS, VOLUME I
P. L. Rice, A. G. Longley, K. A. Norton, and A. P. Barsis NBS, 1 Jan. 1967 196 p refs Revised
(NBS-TN-101)

Comprehensive methods of calculation useful either for explaining or for predicting cumulative distributions of transmission loss for a wide range of radio frequencies over almost any type of terrain and in several climatic regions are presented. Such quantitative estimates of propagation characteristics help to determine how well proposed radio systems will meet requirements for satisfactory service, free from harmful interference. Thus they should provide an important step toward more efficient use of the radio frequency spectrum. The need for comprehensive and accurate calculation methods is clearly demonstrated when measured transmission loss data for a large number of radio paths are shown as a function of path length. The detailed point-to-point methods described depend on propagation path geometry, atmospheric refractivity near the surface of the earth, and specified characteristics of antenna directivity. They have been tested against measurements in the radio frequency range 40 to 10,000 MHz. Estimates of attenuation due to absorption and scattering of radio energy by various constituents of the atmosphere are included in order to extend the application of these methods to frequencies up to 100 GHz. Calculations of long-term median reference values of transmission loss are based on current radio propagation theory. Calculations of transmission loss for paths within the radio horizon are based on geometric-optics ray theory. Author

N67-33753 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
A NEW PROCESS FOR TRANSMITTING DIGITAL DATA OVER THE IRIG-FM/FM TELEMETRY SYSTEM [EIN NEUES VERFAHREN ZUR UEBERTRAGUNG DIGITALER DATEN UEBER DAS IRIG/FM/FM-TELEMETRIESYSTEM]
Philipp Hartl [1966] 15 p refs In GERMAN

Technical details are summarily presented on a joint instrumentation program involving a new coding method for transmitting telemetry data. The communication system described is in relation to the Inter-Range Instrumentation Group. Schematics accompany the technical description of the system. R.U.

N67-33777# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
ANALYSIS OF AN APERTURE ANTENNA SYSTEM LOADED WITH AN INHOMOGENEOUS DIELECTRIC
J. Samuel Bitler May 1967 133 p refs
(Contract DA-28-043-AMC-01870(E))
(TR-7695-180; ECOM-01870-180; AD-653642) CFSTI: HC $3.00/MF $0.65

An analysis is made of an aperture system loaded with an inhomogeneous dielectric. The system consists of two parts. The first part is a section of rectangular waveguide extending from negative infinity along the z-axis to a distance z0 back from an infinite, perfectly conducting ground plane, whose normal is also in the z direction. This section of waveguide is filled with a homogeneous dielectric. The second part is a section of rectangular waveguide of the same dimensions extending from z0 to an aperture in the ground plane. This section of waveguide is filled with an inhomogeneous dielectric. The dielectric is characterized by a permeability and permittivity that varies exponentially with distance from the aperture. At first the waveguide containing the inhomogeneous dielectric was considered to extend to negative infinity. A set of modes was found to satisfy Maxwell's equations and the required aperture symmetries when the field incident at the aperture was a conventional TE10 mode. The fields on the free-space side of the aperture were written in integral form using the free-space Green's Function as a kernel and the aperture electric field as its source. Author (TAB)

N67-33856*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CALCULATION OF SIGNAL MARGINS FOR THE CSM UNIFIED S-BAND DOWNLINK CHANNEL APOLLO AS-202 TO AIRCRAFT NASA 432
David A. Dalgleish Aug. 1966 33 p refs
(NASA-TM-X-55854; X-552-66-424) CFSTI: HC $3.00/MF $0.65
CSCL 17B

Details are presented on the signal margin calculation procedures for tracking acquisition at 500-nmi slant range and data acquisition at 100-nmi slant range. A most likely value and a maximum value were determined, and an unified S-band power level of 10 watts was used. Each part of the calculation procedure is identified and verified in order that mistakes can be easily spotted and corrected. Extensive graphs and tables of the data are included. N.E.N.

N67-33964 Joint Publications Research Service, Washington, D. C.
THE PROBLEM CONCERNING THE RELATIONSHIP OF ENTROPY AND THE QUANTITY OF INFORMATION
V. I. Sharogradskiy 18 Jul. 1967 9 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. (Moscow), no. 2, Mar.–Apr. 1967 p 56–61
(JPRS-41880; TT-67-32511) CFSTI: $3.00

The term information is considered to express the same concept in cybernetics as does the term entropy; and, therefore, the author considers it incorrect to view information as something new that increases in the system with a decrease of entropy. Difficulties and ambiguities resulting from imprecise terminology usage are noted with regard to the various aspects of information theory. Concepts of entropy and information are noted; and the approach to entropy stressed is as a measure of the diversity of states that results in the establishment of natural functioning laws

not only as statistical systems but also as dynamic systems. This permits analysis of control and regulation as processes aimed at decreasing the possible variety of states in a cybernetic system. M.W.R.

N67-33991# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
A DELAYED COMMAND SYSTEM FOR A NEAR-EARTH SATELLITE
Richard S. Cooperman Apr. 1967 99 p refs
(Contract NOw-62-0604-c)
(TG-896; AD-652816) CFSTI: HC $3.00/MF $0.65

The paper describes a digital solid-state delayed command system using a high-accuracy real-time clock designed for near-earth satellites. The system was designed to control the operation of the optical beacon geodesy experiment on the Geos B satellite. Extensive use has been made of high-reliability low-power monolithic integrated circuits for processing and clock circuits; a small magnetic-core memory has been used for data storage. In its present configuration the system can remotely initiate up to 59 separate optical beacon operations per command message. Operations are initiated coincident with any satellite generated minute mark; satellite minute marks are maintained within plus or minus 10 microseconds of universal time. Satellite minute markers are transmitted on three separate carrier frequencies to provide accurate time information on a world-wide basis. System and logical design details are presented. TAB

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-32726# Stanford Research Inst., Menlo Park, Calif.
HIGH-INFORMATION-DENSITY STORAGE SURFACES Quarterly Report, 1 Oct. 1966–31 Dec. 1966
Kendal T. Rogers and John Kelly Apr. 1967 37 p refs
(Contract DA-28-043-AMC-01261(E))
(SRI-5444; ECOM-01261-7; QR-7; AD-651484) CFSTI: HC $3.00/MF $0.65

This program is now devoted to the preparation and investigation of two novel kinds of electron-beam addressable storage elements of about micron size and densely packed arrays of these elements. One kind of element, called a micro-cap, consists of an isolated microcapacitor at the bottom of a hole in a metal-dielectric film sandwich. The other kind, called a micro-ring, consists of an isolated metal film ring embedded concentrically with a hole in a metal-dielectric film sandwich. During this quarter, several techniques for storage and readout on randomly distributed micro-cap storage elements were demonstrated. One storage technique probably involved bombardment-induced conductivity (BIC); however, the presence of BIC in the experiment was not conclusively proved. A new mildly bakeable (400C) field-emitter lens with molybdenum elements, and its associated commercial ultra-high-vacuum system, is being readied for operation. Work on storage structures is proceeding in several concurrent directions. First, the preparation of mosaics having randomly distributed micro-cap elements is continuing. Second, several techniques for producing isolated rings for micro-ring elements are under consideration, and preliminary experimental work on one technique has yielded promising results. Third, efforts are continuing on electron beam techniques for making regular arrays of densely-packed storage elements starting from raster exposure of an electron sensitive resist. Author (TAB)

N67-32735# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
LIST PROCESSING RESEARCH TECHNIQUES Quarterly Report, 15 Sep.–14 Dec. 1966
J. W. Carr, III, H. J. Gray et al May 1967 153 p refs
(Contract DA-28-043-AMC-02377(E))
(Rept.-67-19; QR-2; ECOM-02377-2; AD-652724) CFSTI: HC $3.00/MF $0.65

The second report is of an investigation on the formal characteristics and feasibility of the potential and utilization of push-down type computer memories. Development of software techniques for symbol data manipulation under this study-period concerns the refinement of the SPRINT language. A SPRINT interpreter has been re-written for operation on the IBM 7040. Work has been continued on the Growing Machine whose development is considered to be a test-bed for list processing development. Additional work related to the Growing Machine concept includes an ALGOL recognizer, addition of new push-down operations to the Growing Machine simulator, an analysis of alternate push-down logics, and construction of more complicated mechanisms out of push-downs; using the Growing Machine. A concept of an all push-down machine, in which at least all but a very few of the static registers become a push-down list, and where the main memory is a set of addressed or labeled push-downs, has begun to take shape. The solution to the problem of interconnection, cycling, and contents-interpretation of the push-down lists is to be provided in the two simulated systems under study. The usefulness of push-down memories in conventional and/or unconventional processors is being examined through applications of push-down features in problem areas such as sorting, information retrieval, computation, and language translation. Other applications of list memories under study include push-down list memories as conventional address memories and as secondary storage devices. Linking of lists and using a 100K word associative memory using 1000 hardware FIFOs (first-in, first-out) are also discussed. Author (TAB)

N67-32782# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIODE LOGIC ELEMENTS BUILT AROUND PRINTED MICROSTRIPS FOR SHF RANGE [DIODNYYE LOGICHESKIYE ELEMENTY NA PECHATNOPOLOSKOVYKH LINIYAKH SVCH DIAPAZONA]
V. A. Beruashvili, B. A. Panasenko, and M. I. Namtalishvili 24 Jan. 1967 20 p refs Transl. into ENGLISH from the book "Elementy Kiberneticheskikh Sistem" Tiflis, Izd. AN Gruzin. SSR, 1964 p 1–19
(FTD-MT-67-08; TT-67-62022; AD-652478) CFSTI: HC $3.00/MF $0.65

The article analyzes the possibilities of using waveguide devices of shf range for the construction of logic elements for high-speed digital computers. A description is given of developed AND, OR and NOT elements built around printed microstrips for shf, with the use of amplitude modulation of shf energy by crystal modulators. The half-adder and the three-digit adder are also described. The application of printed microstrips made it possible to obtain logic elements that are simple and small as compared to waveguide type. Diode gate circuits make it possible to attain very high speed of operation, but existing microwave diodes are poorly matched structurally with printed microstrips. A deficiency of printed microstrips is that they permit satisfactory operation only to 6000 Mc. In the 10,000 Mc range it was found that the printed microstrips introduce great losses and distortion. Author (TAB)

N67-32920# Illinois Univ., Urbana. Coordinated Science Lab.
THE PLASMA DISPLAY PANEL. A NEW DEVICE FOR INFORMATION DISPLAY AND STORAGE

B. M. Arora, D. L. Bitzer, H. G. Slottow, and R. H. Willson Apr. 1967 29 p refs
(Contracts DA-28-043-AMC-00073(E); Nonr-3895(08))
(R-346; AD-652590) CFSTI: HC $3.00/MF $0.65

The Plasma Display Panel, invented at the University of Illinois, is a rectangular array of bistable gas discharge cells which are insulated from exciting electrodes by thin glass panels. Combining the properties of memory, display, and high brightness in a simple structure it is an effective, economical device for information display. Author (TAB)

N67-32922# Ballistic Research Labs., Aberdeen Proving Ground, Md.
BRLESC I AND II MEMORY CROSSBAR SWITCH, A HIGH SPEED DIGITAL COMMUNICATION SYSTEM
G. R. Klair and G. L. Herald Mar. 1967 39 p
(BRL-MR-1827; AD-652682) CFSTI: HC $3.00/MF $0.65

The report describes the design and construction of a micro circuit high speed digital communication switching system to be used in a multi-processor computer system. Included are applications to time sharing with memory protect features, and block transfer of information between processors and off line equipment. A detailed description of operation and logic is presented. Author (TAB)

N67-32951# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
LOGIC FUNCTIONS AND SEQUENTIAL MACHINES
Peirre Tison Jun. 1967 113 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1344-66; AFOSR-67-0667; AD-652499) CFSTI: HC $3.00/MF $0.65

The paper presents the application of an algebra of logic functions for the finding of the homomorphic images of sequential machines and leads to some of their decompositions and assignments. The main idea is the formation of groups of internal states from the machine flow-table by application of the concentration, which is the main tool of a new algebra of logic functions generalizing the concensus theory. A variable, called the grouping variable, has been defined and studied. It is more general than the well-known partition which is only one of its homomorphisms. To each machine we can associate a merging function which stresses the correspondence between each possible grouping of the internal states and a sufficient partition allowing this grouping. Each implicant of this function is similar to a partition pair in the sense of Hartmanis and Karp. The principal implicants which are the prime implicants of the merging function, related to binary partitions, can be easily computed. These partitions give the principal groups of states for the machine which play an essential role in finding the simplest homomorphisms, assignments, and machine decompositions. TAB

N67-33008# Sandia Corp., Albuquerque, N. Mex.
DIGITAL COMPUTER PROGRAM FOR THE SIMULATION OF FILTERS AND OTHER TRANSFER FUNCTIONS
D. R. Bjork Apr. 1967 45 p refs
(Contract AT(29-1)-789)
(SC-TM-67-144) CFSTI: HC $3.00/MF $0.65

The filter and transfer function simulator computer program is approached, using a state-variable model for derivation of the response of a given transfer function. The simulator will derive the transfer functions for Butterworth, Chebyshev, Bessel, and all transitional cases of the previous three filters. Simulation is done with fixed-frequency samples. The user needs no computer experience, and must provide only options and parameters. Author (NSA)

N67-33011* North American Aviation, Inc., Los Angeles, Calif.
PROPULSION SYSTEM DYNAMIC SIMULATION USER'S MANUAL
Arnold W. Martin and Heeman W. Wong 17 Apr. 1967 464 p refs
(Contract NAS2-3268)
(NASA-CR-73113; NA-67-385) CSCL 09B

Instructions for using the simulation program in conjunction with the computing program on either the IBM 7094 or IBM 7040/7094 computers are presented. Details are presented on the following operations: selection of simulation logic, configuration, and conditions; checking necessary inputs and recording them; transferring the input data and instructions to punched cards; assembling the card decks; and calculation and printing of simulation data. Sample summary sheets and instructions forms, flow charts and diagrams, initial condition program listings, and a sample run are also included. N.E.N.

N67-33124# Sandia Corp., Albuquerque, N. Mex.
AUTOMATED DIGITAL SHOCK DATA REDUCTION SYSTEM
Walter B. Murfin *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 21–36 refs Sponsored by AEC (See N67-33122 19-32)

A method of automatically digitizing, editing, filtering, reducing, comparing, displaying, and storing shock data is described. The desired final display of the shock data is graphical and can be given in two forms: the acceleration-time history and the shock spectrum. Subsidiary operations include automatic editing of data to eliminate spurious or unwanted points, filtering to remove undesired high-frequency components, or computation of Fourier spectra. An educational program is described which has been found useful for acquainting designers with the utility of the approach. Certain types of pulses which do not lend themselves to the shock spectrum treatment are described, and examples are given showing the flow and presentation of data from rough first look records through final reduction. The mathematical methods for computing shock and Fourier spectra and for filtering are described in sufficient detail to permit adaption to other data systems. Author

N67-33125# Bell Telephone Labs., Whippany, N. J.
AUTOMATED ANALOG METHOD OF SHOCK ANALYSIS
F. X. Prendergast *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 37–45 (See N67-33122 19-32)

An automated analog method for determining the frequency response of various second-order systems to shock inputs is described. The method can be used to perform shock spectrum analysis and to study shock response of various types of nonlinear systems. The unique features are: the analog program is designed to be used with a medium-sized analog computer; automatic frequency stepping is accomplished by the use of multipliers in the analog of the second-order system, instead of potentiometers; and the operating mode of the computer can be slaved to shock pulses, either synthesized within the computer or recorded on magnetic tape. Also described are two methods of plotting frequency response: a simplified technique which results in a bar graph presentation, and a peak detection and sample-hold technique which results in a point-to-point plot. An X-Y plotter can be used as a readout device for either of these methods. Examples are given which demonstrate the use of the method in obtaining shock spectra. A study of a typical nonlinear system's response to shock inputs is also presented. Author

N67-33128# North American Aviation., Downey, Calif.
VIBRATION DATA REDUCTION TECHNIQUES AS APPLIED TO SATURN S-II VEHICLE

Joseph D. Weatherstone et al *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 47–53 (See N67-33122 19-32)

As the S-II vibration data requirements indicated that the number of measurements per test would range from approximately 50 to 100, with a duration from a few seconds to 395 sec, a complete systems concept was employed in planning the data reduction facility. Provisions were made for (1) a high speed analysis subsystem capable of computing the power spectral density (PSD) or average amplitude of a random data signal for each of 50 consecutive frequency segments over a 3 kHz bandwidth in real time; (2) a digital conversion subsystem for converting these data to a digital format recorded on 1/2-in. magnetic tape for processing on a digital computer; (3) detail analysis subsystem for producing analog plots of PSD, cross-spectral density, and transfer functions; and (4) peripheral equipment for reproducing data from the originally recorded format. The vibration analysis program is discussed briefly. It is pointed out that, although the equipment has demonstrated its capability to reduce large amounts of vibration data in a short time, increased emphasis must be placed on developing new methods for utilizing the information. M.G.J.

N67-33127# Wyle Labs., Inc., Huntsville, Ala.
DIGITAL ANALYSIS OF SATURN ENVIRONMENTAL TEST RESPONSE DATA
Daniel J. Bozich *In* NFL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 55–66 refs (See N67-33122 19-32)

Brief technical descriptions are presented on the hybrid analog/digital computer system, the requirements for converting analog data to digital form, the methods used to handle large numbers of channels, the analysis techniques used to reduce the data to engineering terms, and the accuracies and confidence limits of the results. Results are included of a special computer program which can numerically filter the acquired random data into various passbands for more selective analyses. This technique results in increased resolution and accuracy in the lower frequency bands where it is needed. Examples of the results of this program are presented with an analog comparison. Author

N67-33241# California Univ., Livermore. Lawrence Radiation Lab.
SHORT TIME INTERVAL FREQUENCY MEASUREMENTS OF A CONTINUOUSLY CHANGING SINE WAVE
R. E. Marks 27 Feb. 1967 11 p refs
(Contract W-7405-ENG-48)
(UCRL-50188) CFSTI: HC $3.00/MF $0.65

A system was developed to measure the frequency at 1-msec intervals of a sine wave which changed continuously from 25 to 300 kHz within a period of 70 msec. The data were desired in a computer input form. The equipment was developed and successfully used in routine data analysis. The apparatus consists of a series of logic modules. Each module contains a circuit or set of circuits such as a clock, four-bit counter, delay or set of gates which when combined formed the analytic system whose output was in IBM cards. The data were calculated digitally as the amount of time necessary for an integral number of cycles. The data are stored in a magnetic core memory. When the 128-word memory is full, the data are punched onto IBM cards. The system is simple and efficient to use. The accuracy in the stated frequency range is about 0.1%. Author (NSA)

N67-33249# Naval Training Device Center, Orlando, Fla.
A SURVEY OF VARIOUS INFORMATION DISPLAY DEVICES
Elliot B. Kleiman May 1967 19 p refs
(NAVTRADEVCEN-IH-74; AD-653867) CFSTI: HC $3.00/MF $0.65

The report represents a survey of the currently available display equipment that can be controlled by a digital computer. The equipment discussed ranges from simple incandescent readouts to cathode-ray tube displays. The report attempts to very briefly describe the various hardware characteristics and approximate costs of the readout and display field before setting out to design console equipment. Author (TAB)

N67-33258 Commissariat a l'Energie Atomique, Saclay, (France). Centre d'Etudes Nucléaires.
AUTOMATIC ANALYSIS OF GAUSSIAN PEAK SPECTRA [ANALYSE AUTOMATIQUE DE SPECTRES DE GAUSSIENNES]
Jean Picard May 1966 20 p refs In FRENCH; ENGLISH summary
(CEA-R-3024)

A Fortran IV program for automatic analysis of gaussian peak spectra is presented. Author

N67-33267# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCIENTIFIC TECHNICAL CONFERENCE ON THE USE OF COMPUTER TECHNOLOGY IN THE FIELD OF ELECTRIC POWER ENGINEERING
A. A. Tayts 14 Mar. 1967 19 p Transl. into ENGLISH from Elektr. Stanstii, no. 8, 1965 p 87–90
(FTD-HT-66-759; AD-653540) CFSTI: HC $3.00/MF $0.65

The article discusses the developments of a technical conference on the use of computer technology in the field of electric power engineering held December 23–28, 1964 in Moscow. More than forty papers were presented by various organizations. It was noted that the use of computers in electric power engineering is one of the leading trends in scientific research in planning, designing, and organization of the exploitation in electric power engineering. At present regular calculations are being made of regimes of the Ukr SSR electric power system on the Ural-2 computer, daily schedules of the electric power demand in large power supply systems such as YeES (United Power System) of the European part of the USSR are being predicted, computer calculations are being made of the optimal distribution of active loads between electric power stations and systems, and calculations are being made of the optimal positioning of compensating devices in power supply systems. The importance was noted of using results of scientific research in cybernetics for solving problems on the optimization of the development and control of power systems using computer technology. The conference noted a need to create an all-union library of typical programs for standard computers. Author (TAB)

N67-33297# Illinois Univ., Urbana. Coordinated Science Lab.
COMPATIBILITY AND ROW-COLUMN MINIMIZATION OF SEQUENTIAL MACHINES
Gerald John Lipovski May 1967 102 p refs
(Contract DA-28-043-AMC-0073(E))
(R-355; AD-654030) CFSTI: HC $3.00/MF $0.65

The abstract framework in which reduction of a sequential machine takes place is studied. The covering and closure conditions are derived from a conceptually simple notion of compatible total states and a Boolean algebra is explored which is used to transform these conditions into mappings that produce compatible machines. An algorithm based on a product-of-sums written in this algebra is presented. An algorithm based on a distributed sum-of-products in the same algebra is developed. This second algorithm appears simpler and more appealing. Author (TAB)

N67-33318*# Illinois Univ., Urbana. Coordinated Science Lab.
A PROCEDURE FOR RANKING DIAGNOSTIC TEST INPUTS
Theo J. Powell May 1967 61 p refs Supported by NASA (Contract DA-28-043-AMC-00073(E))
(NASA-CR-87362; R-354; AD-653523) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Contents: Package level diagnosis; Prime implicant diagnostic procedure; Probability weighting procedure; Assumed number of outputs; Example with probabilistic weights; Comparison; Probabilistic weight formula; Weight formula derivation; Multi-output example; Future work and conclusions; Sequential machine extension; Future research areas. Author (TAB)

N67-33348# Naval Ordnance Lab., White Oak, Md.
DARE SUPPORT PACKAGE
Jane S. Hebbert and Mary E. Beszterczei 1 May 1967 86 p
(NOLTR-67-26; AD-653854) CFSTI: HC $3.00/MF $0.65

The FORTRAN IV DARE Support Package is a set of programs used at the Naval Ordnance Laboratory to manage raw data tapes recorded from Supersonic Tunnel 1 or Hypersonic Tunnel 8 by EPSCO I or EPSCO II recording systems. The package is comprised of three sections for each tunnel: LISTER edits and lists the raw data; EDIT reads, edits and presents the raw data on tapes for further processing; STACKER stacks, verifies and lists raw data tapes. The report describes the usage and supplies the listings for the DARE Support Package. Author (TAB)

N67-33380*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ADAPTIVE STABILIZATION COMPUTER
A. G. Carlton and L. M. Spetner *In its* Res. and Develop. Programs Mar. 1967 1 p (See N67-33361 19-34)

Ship-motion data indicate that the autocorrelation of both the roll and the pitch motion can be represented by an exponential cosine, from which good estimates of parameters can be made to permit flexible capability for predicting ship motion. The correlation coefficient for a discrete random process used for estimating the process parameters is considered. M.W.R.

N67-33477# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE GEORGIAN SSR INSTITUTE OF ELECTRONICS, AUTOMATION AND REMOTE CONTROL
20 Mar. 1967 68 p refs Transl. into ENGLISH from Tr. Inst. Elektron. Avtomat. Telemekhan., Akad. Nauk Gruz. SSR, v. 4, 1963 p 21–43, 97–113
(FTD-MT-65-481; AD-652474)

CONTENTS:

1. CERTAIN QUESTIONS OF AUTOMATIC IDENTIFICATION OF SPEECH SIGNALS AND CONTROL OF MACHINES WITH THE USE OF SPEECH A. G. Kakuridze p 1–37 refs (See N67-33478 19-07)

2. MAGNETIC OPERATIONAL MEMORY UNIT AND ITS INPUT DEVICE FOR CONTROLLING COMPUTERS Sh. G. Lelashvili, T. G. Khundadze, and Sh. A. Tsintsadze p 39–58 refs (See N67-33479 18-08)

N67-33479# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC OPERATIONAL MEMORY UNIT AND ITS INPUT DEVICE FOR CONTROLLING COMPUTERS
Sh. G. Lelashvili, T. G. Khundadze, and Sh. A. Tsintsadze *In its* Acad. of Sci. of the Georgian SSR Inst. of Electron. Automation and Remote Control 20 Mar. 1967 p 39–58 refs (See N67-33477 19-08)

Two types of internal magnetic memories, with original input units containing ferrites and transistors, were developed. The memories are used in the automatic control for the pressure rollers of blooming mills. The two memories operate by half-current coincidence and by dynamic magnetization, respectively. A simple and effective method for stabilizing the writing currents was obtained for the second variant, with the dependence of the writing-pulse amplitude on the supply voltage eliminated, and without the use of any stabilized voltages or supplementary elements. The operating principles and the main blocks of both systems are described in detail, along with the logic and the operating sequence of the input unit. It is claimed that the simplicity, reliability, and compactness of this internal memory make it suitable for use in many systems for programmed control of manufacturing processes, and the simplicity, reliability, and operating convenience of the input unit make it suitable for use in various computers, particularly of the control and information type. Author

N67-33620* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
DATA HANDLING AND ANALYSIS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 250–256 (See N67-33593 19-10)

Data research handling and analyses used in agricultural remote sensing are considered briefly. Effort was directed toward making available to the data analysis researcher appropriate quantities of data in an easily useable format, and to developing suitable equipment and techniques so that the data processing capability can grow at a rate commensurate with the rest of the remote sensing program. An analysis was made of the principal components of statistical analysis and modeling work. Field spectroscopy experiments centered on the use of three Block interferometer spectrometers. R.U.

N67-33638# European Space Data Centre, Darmstadt (West Germany).
SOME CHARACTERISTICS OF HARDWARE AND SOFTWARE OF THIRD-GENERATION COMPUTERS
K. Debatin Paris, ESRO, Dec. 1966 17 p refs
(ESRO-TM-52) CFSTI: HC $3.00/MF $0.65

It is the purpose of this paper to clarify some technical terms used with large scale computers. Although the terms are not defined and are often used in a confusing manner, it is beneficial to explain the terms according to current conventions. Author (ESRO)

N67-33639*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MONTE CARLO CODE FOR SOLUTION OF PLANAR ELECTRON-DIODE PROBLEMS INCLUDING ELECTRON-NEUTRAL ELASTIC COLLISIONS
Paul Swigert and Charles M. Goldstein Washington, NASA, Aug. 1967 138 p refs
(NASA-TN-4043) CFSTI: $3.00 CSCL 20H

A Monte Carlo electron transport code for the self-consistent potential solutions of one-dimensional planar electron–diode problems including electron-neutral elastic collisions capable of employing differential scattering cross sections is presented. An analytical description of a class of problems for which this code was written and the methods and techniques for solution of these problems are also presented. The code is given including instructions for the user, flow charts, and listings of all Fortran IV programs. Also included is material on curve and surface fits, convergence of a second-order differential equation, machine language routines, and a sample problem. Author

N67-33699# California Univ., Berkeley. Lawrence Radiation Lab.
COBWEB: IBM-7044 ON-LINE BUBBLE CHAMBER FILM MEASURING MACHINES
Eugene P. Binnall and Myron H. Myers 19 Sep. 1966 28 p refs Presented at the AEC Inform. Meeting, Eng. Sect., New York, 28–30 Sep. 1966
(Contract W-7405-ENG-48)
(UCRL-17136; CONF-660947-2) CFSTI: HC $3.00/MF $0.65

The engineering and programming aspects of the Berkeley Cobweb system are described. Cobweb is a system of Frankensteins and measuring microscopes on-line to an IBM-7044 computer. Outlines of the system hardware and software are presented. A brief example illustrating the operation of an on-line Frankenstein is given. Author (NSA)

N67-33722# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Institut fuer Raumsimulation.
THE DIGITAL DATA ACQUISION SYSTEM FOR THE BIG SPACE SIMULATION CHAMBER OF THE INSTITUT FUER RAUMSIMULATION OF THE DVL [DIE DATENERFASSUNG-SANLAGE FUR DIE GROSSE RAUMSIMULATIONSKAMMER DES INSTITUTS FUER RAUMSIMULATION DER DVL]
Klaus Kramp May 1967 38 p refs In GERMAN; ENGLISH summary
(DLR-MITT.-67-08; DVL-647) CFSTI: HC $3.00/MF $0.65

Those requirements that must be fulfilled by a digital data acquisition system are described. Some measuring problems are discussed, and the subsystems of the data system are described in more detail. The functioning of the system is shown in block diagrams. Author

N67-33817# Argonne National Lab., Ill.
DIGITAL-COMPUTER APPLICATIONS TO ELECTRON MICROSCOPY
James W. Butler *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 175–176 refs (See N67-33781 19-14)

The use of computers in accelerating the design and application of electron microscopes is discussed. It is considered possible that techniques of digital processing of pictorial data to aid in human interpretation may be applicable to the electron microscope since it may be feasible to combine the results of multiple scans. It is suggested that the digital scanning and image processing system could be modeled closely after the existing Chloe system, with necessary modifications due to the extremely high resolution of the microscope. It is not considered necessary to have a powerful computer directly connected to the microscope, as it would be more economical to run the data processing programs on other large computers. M.G.J.

N67-33820# Argonne National Lab., Ill.
A COMPUTER CODE FOR CALCULATING THE SPREADING OF HIGH-ENERGY ELECTRONS IN DETECTOR MATERIALS
Charles E. Cohn and J. H. Roberts (Northwestern Univ.) *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 180–181 refs (See N67-33781 19-14)

A CDC-3600 Fortran code is presented to calculate the spreading of electron paths in various detector materials due to multiple scattering. This allows an estimate of the electron-image resolution and energy deposition in a detector of a given thickness. The theory of multiple scattering provides means for calculating the mean-square lateral spreading distance, after traversal of material of thickness. However, this is an overly pessimistic estimate of the spreading, since this is a maximum distance and most of the energy is deposited with less spread. Therefore, the code calculates an effective spreading diameter by dividing the total thickness into layers. Author

N67-33836# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A UNIVERSAL PROGRAMMING LANGUAGE (ALGOL 60)
S. S. Lavrov 23 Mar. 1967 180 p refs Transl. into ENGLISH of the book "Universal'nyy Yazyk Programmirovaniya" Moscow, Izd. Nauka, 1964 p 1–171
(FTD-HT-66-382; TT-67-62148; AD-653984) CFSTI: HC $3.00/MF $0.65

This book is a manual for the study of the international algorithmic language ALGOL 60 intended for the complete and concise description of computation processes by means similar to the conventional mathematical symbolism. The language is an important auxiliary for electronic computers. The book is intended for engineers, who have to deal with calculations on electronic computers in their work without being specially trained in this. Author (TAB)

N67-33847# Pennsylvania Univ., Philadelphia.
AUTOMATIC TRACK FOLLOWING PROGRAM AT THE UNIVERSITY OF PENNSYLVANIA
E. Bogart, H. Brody, S. Brooks, W. Churchill, S. Hagopian et al [1967] 15 p Presented at the Intern. Conf. on Programming for Flying Spot Devices, Munich, 18–20 Jan. 1967
(Contract AT(30-1)-2171)
(NYO-2171-222; CONF-670105-4) CFSTI: HC $3.00/MF $0.65

Characteristics of an automatic system for processing bubble chamber pictures using the HPD are presented: the data processing scheme is for the $\pi^- + P$ interaction, the system is an off-line system of production, the programming is written completely in Fortran (except for trivial I–O and packing routines), prescanning of the film is possible, and pictures are only taken when an event occurs. NSA

N67-33892*# Arizona Univ., Tucson.
A NEW DIGITAL ATTENUATOR SYSTEM FOR HYBRID COMPUTERS
Conrad Paul Pracht 1967 10 p refs
(Grant NGR-03-002-091)
(NASA-CR-87287) CSCL 09B

Digital attenuators are simple multiplying digital-to-analog converters used to replace coefficient-setting potentiometers in modern analog/hybrid computers. This report describes a new digital attenuator system employing low-phase-shift miniature metal-film ladder networks. They are switched by latching reed relays which give the system a nondestructive coefficient memory even when the computer is switched off. New digital control logic employs serial data transmission and requires only one address line per 14-bit attenuator. It permits one to set all 200 attenuators of a typical hybrid computer installation within 20 milliseconds. For maximum contact life, relay contacts are switched only when no current is flowing. The digital computer static-check routine can readily check individual relays to simplify maintenance. Particular emphasis in this report is on a digital–attenuator system designed for a very fast repetitive computer in the Analog/Hybrid Computing Laboratory at the University of Arizona. The same design approach is readily applied to "slow" analog computers and appears to be even more advantageous there. Author

N67-33939*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC COMPUTER TAPE (REHABILITATION) PROCEDURES AND RESULTS
Virgil H. Byrd Apr. 1967 87 p
(NASA-TM-X-55779; X-534-67-204) CSCL 09B

Wet and dry methods of magnetic tape cleaning were studied in order to determine the most effective combinations for rehabilitating used tapes. The causes of loss of signal (drop-out) are identified

and classified according to contamination, oxide roughness, and backing damage. In evaluating the cleaning methods, 103 tapes were tested and the drop-outs classified and divided into two groups of equal magnitude of drop-out count. The results of the pilot runs are tabulated. It is concluded that the most effective cleaning is achieved by a combination of both types, as neither of the single methods produces a satisfactory system. M.G.J.

N67-33984# National Bureau of Standards, Washington, D. C. Computer Technology Section.
COMPUTER/DISPLAY INTERFACE STUDY Quarterly Report, 1 Apr.–30 Jun. 1966
Jul. 1966 62 p refs
(ECOM-95829-1; NBS-9423; NBS-9495; QR-1; Rept.-1; AD-651283) CFSTI: HC $3.00/MF $0.65

Summarizing the status of the program in the field of man-computer communication in the Computer Technology Section, National Bureau of Standards, this report includes details of the research facility which operates on the MOBIDIC B twin processor computer system in a time-shared mode. It also includes brief reports on the MAGIC display subsystem and the FOSDIC VI flying spot scanner. The appendices describe the NBS CORD Time-Sharing System. Author (TAB)

N67-33985# National Bureau of Standards, Washington, D. C. Computer Technology Section.
CORD: A TIME-SHARING EXECUTIVE FOR A RESEARCH FACILITY
Thomas N. Pyke, Jr. *In its* Computer/Display Interface Study Jul. 1966 19 p refs (See N67-33984 19-08)

CORD, an operating system for a computer with online remote devices, is an executive program for a time-shared computer system which serves several remote terminals operating in a research and development facility. A general executive that satisfies the requirements of a variety of experimental terminals has been developed. The generalized system provides the flexibility necessary for research in man-machine communication utilizing a variety of devices connected to a computer system. Author

N67-33986# National Bureau of Standards, Washington, D. C. Computer Technology Section.
THE NBS CORD TIME SHARING SYSTEM: A REFERENCE MANUAL
In its Computer/Display Interface Study Jul. 1966 29 p ref (See N67-33984 19-08)

Information to use a computer with on-line remote devices (CORD) time-sharing system from a teletype terminal is presented in this reference manual; and operational status is described as of December 1966. Part of the basic system, including activation of the disk file, was not fully operational as of this date. The login procedure as well as the entering system commands and all subsequent system commands are described. Programs that can be run in the time-shared mode are noted; and mention is made of the user program instruction format and operation description, CORD command vectors, error returns and messages, and user processor constants and internal character representations. M.W.R.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N67-32711# Autonetics, Anaheim, Calif. Research and Engineering Div.
FURTHER RESEARCH ON OPTICAL TRANSMISSION LINES
C. B. Shaw, Jr., B. T. French and Charles Warner, III May 1967 81 p refs
(Contract AF 49(638)-1504)
(C7-929/501; AFOSR-67-1113; SR-2; AD-652501) CFSTI: HC $3.00/MF $0.65

Theoretical and experimental research was conducted on the basic phenomena underlying operation of thin film dielectric structures as electromagnetic waveguides at optical frequencies. An outstanding accomplishment for the period was successful computation of dispersion curves for dominant odd and even modes of dielectric waveguides of finite rectangular cross section. Analysis was based on a variational technique in which the relative dielectric constant of the waveguide is sought as the stationary eigenvalue of a fundamental waveguide integral equation. The basic obstacle to more general numerical analysis based on the fundamental equation is its singular kernel. This fact motivated research in applied mathematics, from which evolved a novel technique for solution of such problems. While not yet conclusive, early tests of the latter technique are very promising. Experimental results include measurements of the far-field diffraction pattern for light transmitted through thin film dielectric waveguides. Both coherent (laser) and incoherent sources were used. Polarization effects in the new field have also been studied. Minute structural imperfections in the thin films can now be detected and avoided. Author (TAB)

N67-32725# Temple Univ., Philadelphia, Pa. Dept. of Physics.
STUDY OF HIGH ENERGY, HIGH DENSITY DISCHARGES AND HIGH TEMPERATURE MEASUREMENTS AS APPLIED TO EXPLODING WIRES Final Report, 1 Mar. 1962–28 Feb. 1967
Theodore Korneff 1 May 1967 30 p refs
(Contract AF 19(628)-215)
(AFCRL-67-0276; AD-652237) CFSTI: HC $3.00/MF $0.65

The report describes the experimental investigations of exploding wire phenomena in various atmospheres and pressures, the determination of energy dissipated in an exploding wire and in the associated airgap switch by means of simultaneous voltage and current measurements, and the development of a 3-color optical pyrometer with resolving time of the order of 0.1 microseconds. Brief descriptions of a number of investigations undertaken in these areas are presented, and in each case reference is made to appropriate publications from which detailed information may be obtained. Author (TAB)

N67-32731# Naval Avionics Facility, Indianapolis, Ind.
MICROELECTRONICS ENGINEERING. DESIGN, FABRICATION, MATERIALS AND PACKAGING
Jan. 1965 97 p refs
(NAFI-TP-202; AD-652388) CFSTI: HC $3.00/MF $0.65

Content: Design considerations and methods using advanced electronic fabrication techniques; A survey of microelectronic technology; Vacuum technology; Guidelines for design and layout of thin-film circuits; Functional design using microelectronic techniques; Common materials encountered in microelectronics; Heat transfer design considerations for microelectronic modules; Microelectronic electrical connection techniques; Microelectronic packaging techniques. Author (TAB)

N67-32895# Harry Diamond Labs., Washington, D. C.
A PASSIVE METHOD OF IMPROVING COMMON-MODE REJECTION
Karl H. Krey Apr. 1967 37 p refs
(HDL-TR-1347; AD-652877) CFSTI: HC $3.00/MF $0.65

Theory and experimental results are given which show that considerable common-mode rejection can be achieved with a passive magnetic device. Equations are developed which give the characteristics of differential and common-mode input impedances. Rejection ratios as high as 90 dB were obtained experimentally. For frequencies extending from 10 Hz to 10 MHz, the common-mode rejection was in excess of 83 dB. Simultaneously, differential-mode signals of approximately the same frequency range were passed without distortion and with less than 1/2-dB attenuation. Rectangular pulses of 20-nsec rise time were also passed in the differential mode without noticeable distortion. The given results can be improved substantially in specific applications. TAB

N67-32897# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
CYCLOTRON WAVE DEVICES STUDY
T. Kao, D. C. Watson, K. I. Talbot, C. H. Durney, C. C. Johnson et al
Dec. 1966 39 p refs
(Contract DA-36-AMC-02372(E))
(MD-66-025; EC-3; QR-8; ECOM-02372-3; AD-653011)

An analysis of force-free mode coupling in the Cuccia coupler is carried out to supplement the transverse mode coupling analysis. The complete analytical and experimental results on the cyclotron-synchronous wave amplifier are available in AD-653 009. A computer analysis of the power converter was carried out which includes space-charge and finite beam size effects. These calculations give results not too different than the filamentary beam results. Using the same space-charge beam model as that used in the power converter analysis, a beam stability computer calculation was carried out for the amplifier. The results are somewhat different than the published curves of Sackinger and Buck, and Bass. Author (TAB)

N67-32928# California Univ., Berkeley. Lawrence Radiation Lab.
DEVELOPMENT OF 2000-AMPERE DIODES FOR HIGH CURRENT FERRITE BIASING SUPPLIES
R. F. Tusting, J. E. Katz, and O. A. Kerns 17 Mar. 1967 15 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17457; CONF-670307-34) CFSTI: HC $3.00/MF $0.65

Ferrite tuning circuits of the rf system for the 200-GeV machine require specialized components, because of the requirements for high current and for reliability under pulsing conditions. The present status of the LRL program to provide high-current supplies for ferrite biasing is described. Author (NSA)

N67-32938# Naval Air Development Center, Johnsville, Pa. Aero-Electronic Technology Dept.
DIRECTIONAL CHARACTERISTICS OF SLOTTED PIEZOELECTRIC CERAMIC TUBES Final Report
J. A. Devine 18 Apr. 1967 36 p refs
(NADC-AE-6709; AD-652344) CFSTI: HC $3.00/MF $0.65

Single element and line transducers of various dimensions were fabricated from radially polarized, slotted piezoelectric ceramic tubes. The tubes exhibited multilobe directivity characteristics, in a plane normal to the axis of the tubes, at certain discrete frequencies. The shape of the directivity patterns are explained in terms of circumferential extensional vibrations with geometrically determined nodal positions. In addition, unidirectional response patterns were found at frequencies that were below the fundamental breathing mode of the tubes. Author (TAB)

N67-32870# Hewlett-Packard Co., Beverly, Mass. Frequency and Time Div.
CESIUM TUBE DEVELOPMENT Interim Development Report 19 Dec. 1966–19 Apr. 1967
Joseph H. Holloway 1 May 1967 19 p refs
(Contract N00024-67-C-1048)
(M-1048-QI; AD-652397) CFSTI: HC $3.00/MF $0.65

Two approaches were followed in the cesium oven design and tests were performed on ovens representing each design. The objective in the oven design is to obtain good reliability with a minimum of complexity. The choice of oven design is not yet settled. Some tests were performed to measure the ionization efficiency of various ionizer materials, but the preliminary results were inconclusive, due to an inadequacy in the experimental design. An improved cesium getter test apparatus was designed and built. It is ready to receive the first test samples. These samples can be irradiated with more than 10 to the 22nd power atoms/sq cm, using the new test apparatus, which should be adequate for the required getter evaluations. Measurements were made of the performance of dipole and multipole optics tubes under acceleration, using a rotating table to produce the acceleration. This is the first time such a quantitative measurement has been made on a multipole tube. The results showed that the total signal level should change less than 1 percent for a spin rate of 10 rpm. Thus the improved performance under acceleration, which is expected theoretically for multipole optics systems, has been verified experimentally. Author (TAB)

N67-33001# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
ELECTRON SYNCHRONOUS WAVE AMPLIFIER
Tai-Wu Kao and C. C. Johnson Dec. 1966 135 p refs
(Contract DA-36-AMC-02372(E))
(MD-66-023; EC-1; ECOM-02372-1; AD-653009) CFSTI: HC $3.00/MF $0.65

The cyclotron-synchronous wave electron beam microwave amplifier is investigated. Coupling of the electron beam waves by the d-c space-charge forces and the spatially-varying d-c pump fields is examined, subject to the beam focusing conditions. The small signal assumption is made, and polarization variables are used to analyze the wave behavior in coupled-mode form for both the rotating and nonrotating electron beam cases. Force-free modes and transverse modes are obtained by solving the force equation. Nonlinear variation of the electrostatic pump field in the ring-type pump structure is considered. The gain of the cyclotron-synchronous coupling mechanism and the kinetic power density carried by the beam modes are not uniform across the beam cross section, as indicated in the filamentary beam analysis. The variations are significant only for a thick beam. Analysis shows that at omega = (omega sub c), the Cuccia cavity couples to the transverse modes strongly, but no coupling to the force-free waves is possible. Experimental results of the amplifier with Cuccia cavities as the coupling elements are included. Author (TAB)

N67-33104# Loral Electronics Corp., New York.
WIDE BAND FERRIMAGNETIC LIMITER STUDY Interim Report, 24 Nov.–28 Feb. 1967
A. Christopher and J. Moyse Apr. 1967 39 p refs
(Contract AF 30(602)-67-C-0062)
(RADC-TR-67-160; AD-652248) CFSTI: HC $3.00/MF $0.65

The relationship between the low K-spin wave region, the limits of the Walker Mode spectrum, gyromagnetic resonance, and the availability of first order process limiting is reviewed and presented in a normalized graphical form. With the uniform precession biased first in the coincidence, and then the subsidiary resonance absorption region, close agreement is shown between the predicted and experimentally determined bottom of the spin wave manifold, as determined by the availability of spin waves for first order process limiting. Leading spike phenomenon was observed over an octave band. Efforts to increase the dynamic range are discussed utilizing various transmission line structures. A novel type of

electronically tunable bandpass filter is discussed in which there is a series resonance between the parallel RLC circuit of a ferrite resonator and a lumped reactance. Experiments in P-band indicate that, except for the increased losses and decreased coupling due to high linewidth and low 4 pi M sub s, an octave band all pass filter can be constructed. X-band experiments indicate that the main problems in building an octave band all pass filter are excessive cable losses and tracking problems. Author (TAB)

N67-33130# Navy Electronics Lab., San Diego, Calif.
COMBINED ENVIRONMENT TESTING OF SHIPBOARD ELECTRONIC EQUIPMENT AND UTILIZATION OF REGRESSION ANALYSIS
Floyd Robinson *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 83–90 refs (See N67-33122 19-32)

The intermediate frequency, amplitude modulation (IF/AM) amplifier modules were subjected to 450 hours of test during which failure of a mechanical filter and unsatisfactory performance were observed. Field data on the module indicated that identical problems had occurred in the field. A regression analysis was performed on 150 hr of recorded test data in an effort to find a technique that would aid in predicting and assessing the effects of the various environmental factors. The partial coefficients of the linear multiple regression equation were used as indicators of the environmental factor that contributed more toward the degradation of the test specimens. The results of the technique appear encouraging. Author

N67-33141# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
MICROMINIATURE INSTRUMENTATION AMPLIFIERS
W. V. Bratkowski and P. F. Pittman *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 215–223 (See N67-33122 19-32)

The molecular electronics technique is discussed in conjunction with the development of microminiature instrumentation amplifiers suitable for use with conventional low- and high-impedance transducers. A monolithic linear integrated circuit is used in the design; its advantages are cited as small size and low weight, well-matched device characteristics, excellent device thermal tracking, low noise, high reliability, and low cost. The development of two families of microminiature amplifiers is described: These include two low-impedance or strain gauge devices, one with a fixed gain of 250, the other with a gain variable up to 500; and a high-impedance amplifier with a fixed gain of 15. M.G.J.

N67-33157# Joint Publications Research Service, Washington, D. C.
AUTOMATIC DEVICE FOR PRODUCING MICROCIRCUITS
V. Arkhipchuk *In its* Current Appl. of Cybernetics in the USSR 28 Jun. 1967 p 7–8 Transl. into ENGLISH from Pravda Ukr. (Kiev), 5 May 1967 p 4 (See N67-33155 19-10)

A special transistorized computer was designed for controlling the technological processes of microcircuit production. Electron-ion beam methods programmed on this digital computer are used for producing microcircuits for electronic instruments. The process lends itself to the production of tunnel diodes, certain types of transistors, microwelds, and etchings. The operations are carried out in a vacuum chamber to insure high quality. The computer meets the high-speed demands of electron beam technology; it is programmed by means of a keyboard and has an electroluminescent screen and a dark-trace tube for monitoring the production process. K.W.

N67-33220# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
RESEARCH ON DISTRIBUTED FERRITES FOR CROSSED-FIELD MICROWAVE DEVICES Quarterly Report, 10 Aug.–9 Nov. 1966
William A. Smith, Daniel Masse, John M. Osepchuk, Robert Plumridge, and Lawrence Tisdale May 1967 43 p ref
(Contract DA-28-043-AMC-02032(E); ARPA Order 679; Proj. Defender)
(PR-3; Rept.-3, Pt. 1282; ECOM-02032-3; AD-653638) CFSTI: HC $3.00/MF $0.65

The objective of this program is to develop the knowledge and technology necessary to take full advantage of the unidirectional attenuative properties of ferrites in achieving improved gain and bandwidth in crossed-field microwave amplifiers and oscillators. During the third quarterly period, activities included cold testing of ferrite materials in conjunction with an L-band helix, and an investigation of narrow linewidth ferrites in an S-band Amplitron. Theoretical and Experimental studies have indicated that broadbanding of ferrites in a CFA can be accomplished by broader linewidths, porous ferrites, or by a combination of both methods. Measurements made on a porous magnesium ferrite support this conclusion. Bonding of ferrites to dielectric can be effected by the use of glass frit, and bonding to copper can be accomplished by sputtering nickel onto the ferrite in an argon atmosphere and subsequently brazing with silfos solder. Author (TAB)

N67-33221* Ithaco, Inc., Ithaca, N. Y.
LOW-NOISE AMPLIFIER DESIGN WITH FIELD-EFFECT TRANSISTORS, VOLUME I Final Report
7 Sep. 1964 265 p refs
(Contract NAS5-3682)
(NASA-CR-87325) CSCL 09A

The fundamentals of field effect transistor (FET) circuit design are described, and details are given on techniques for biasing FETs and for amplifier designs. Characteristics of random noise are considered in order to determine methods for producing optimum low noise circuit designs. These characteristics are categorized as the natural noise generated by all devices, and the unnatural noise which results from device imperfections. Methods of measuring and specifying noise for different applications are assessed. As the techniques used in amplifier design affect the low noise performance that can be achieved, attention is focused on the effects which should be considered and the techniques to be used. These include the use of negative feedback and the elimination of subsequent stage noise; noise due to bootstrapping; noise with capacitive sources; accommodation of the input noise spectrum; and the use of an input transformer. Data are presented on noise measurements made on several commercially available devices, and schematics amplify the design and performance information given on three low noise FET amplifiers. M.G.J.

N67-33248*# Radio Corp. of America, Somerville, N. J.
THE DESIGN AND DEVELOPMENT OF A SILICON ULTRA-HIGH FREQUENCY POWER TRANSISTOR CAPABLE OF DELIVERING 20 WATTS OF OUTPUT POWER AT 430 MC WITH A MINIMUM EFFICIENCY OF 50 PERCENT AND A POWER GAIN OF 6 dB Final Report, 29 Jun. 1964–1 Dec. 1966
1 Dec. 1965 122 p refs
(Contract NAS8-3705)
(NASA-CR-87319) CSCL 09A

Development of a silicon ultrahigh frequency power transistor capable of delivering 20 watts of output power at 430 megacycles with a minimum efficiency of 50 percent and a power gain of 6 dB is described. To minimize parasitic capacitance, the emitter periphery dictated by the output power requirements of the device

must be contained within the smallest possible base area. An improved overlay structure was developed to achieve this aim. Several package configurations of improved overlay structure were investigated to reduce emitter lead inductances. Results led to a final design that incorporated a long pellet with a base aspect ratio of 10 to 1 for low emitter lead inductance. The package design indicates that significant improvements in power gain can be obtained by further improvements in packaging. S.P.

N67-33362# Radio Corp. of America, New York. Advanced Communications Technology Lab.
MICROMINIATURE MONOLITHIC CROSSPOINT INTERCONNECTIONS Quarterly Report, 1 Jan.–31 Mar. 1967
S. Yuan, W. H. Buchsbaum, M. Kalet, and L. Spann. Army Electron. Command, Ft. Monmouth, N. J., Jun. 1967 29 p
(Contract DA-28-043-AMC-02260(E))
(Rept.-329; ECOM-02260-3; AD-653597) CFSTI: HC $3.00/MF $0.65

The report describes the circuit and the fabrication aspects of the microminiature monolithic crosspoints. The tolerances of the shunt resistances are determined by computer studies. Power required to operate the control gates at various supply voltages for the 1×1 crosspoints is given. The effect of adhesive material on the nichrome thin-film resistors is presented. Methods of providing feed throughs are described and results given. Other approaches of fabricating the crosspoints are briefly discussed with respect to their manufacturability. Author (TAB)

N67-33382*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THIN-FILM TECHNOLOGY DEVELOPMENT
C. S. Morris *In its* Res. and Develop. Programs Mar. 1967 1 p (See N67-33361 19-34)

Thin film interconnect patterns were developed for three hybrid satellite resistor, diode and transistor circuit applications, namely the source sink driver, gated driver, and diode array. The transistors and diodes are discrete components. Because it has higher thermal conductivity than glass, aluminum oxide was found to be a useful substrate for the deposition of chromium transistors; and some 27,000-ohm resistors were fabricated to an accuracy of ±2.5%. M.W.R.

N67-33383*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MICROELECTRONIC PACKAGING
C. F. Noyes *In its* Res. and Develop. Programs Mar. 1967 1 p (See N67-33361 19-34)

Hybrid assembly processes are considered for the packaging of thin film and semiconductor microelectronic devices. All processes, including flight acceptance tests, were established for the hybrid circuit required by a laboratory space vehicle; and testing of the circuit for one satellite indicates that tests at critical points in the assembly can save both manpower and material. A packaging scheme for a radar subsystem is underway. M.W.R.

N67-33384*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SEMICONDUCTOR DIFFUSION TECHNOLOGY
C. S. Morris *In its* Res. and Develop. Programs Mar. 1967 1 p ref (See N67-33361 19-34)

Production capability is considered for specific monolithic and hybrid semiconductor circuits; and a standard test mask, incorporating transistor and resistor patterns, was designed for controlling semiconductor processing. A study indicates that oxide and photoresist defects can be calculated before device fabrication from the circuit layout geometry, and attempts are underway to develop a better photoresist. Metal oxide silicon (MOS) capacitors were produced that are 17 mils square and have a value of approximately 50 pf. M.W.R.

N67-33405# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVELOPMENT OF SEMICONDUCTOR DEVICES
Hsieh Hsi-teh 25 Jan. 1967 13 p Transl. into ENGLISH from Tien-tzu Chi-shu (Shanghai), no. 4, 1964 p 1–3
(FTD-TT-65-1066; AD-653512) CFSTI: HC $3.00/MF $0.65

Rapid progresses are made in the development of semiconductor devices such as transistors and semiconductor solid circuits. Germanium triodes having a cutoff frequency as high as 4200 mc/sec and silicon transistors having an operating frequency of 500 mc/sec and an output power of 1.5 w have been developed. New techniques used in semiconductor device production are: isotope techniques for analyzing the impurity contents in germanium, silicon, and other semiconductor materials; optical engraving process and microphotography for multiple circuit printing and geometric projection; filming process in the production of flat silicon triodes, capacitors, and resistors having a diffused antimonial base and a boron emitter. Semiconductor lasers having a gallium arsenide diode or an indium arsenide diode developed in recent years are based on the fundamental theories of physics. Author concludes that the applications of semiconductor devices must be extended to different industries and new processes must be developed to facilitate semiconductor device production. Author (TAB)

N67-33429# General Electric Co., Schenectady, N. Y. Research and Development Center, K-1.
NEW SOLID-STATE DEVICE CONCEPTS Scientific Interim Report
M. Aven, W. Garwacki, R. B. Hall, R. N. Hall, J. R. Richardson, and H. H. Woodbury Dec. 1966 86 p refs
(Contract AF 19(628)-4976)
(AFCRL-67-0046; SR-7; AD-649334) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. MECHANISM OF CHARGE TRANSPORT AND LIGHT EMISSION IN $ZnSe_xTe_{1-x}$ p–n JUNCTIONS M. Aven and W. Garwacki p 1–26 refs (See N67-33430 19-26)
2. DIFFUSION OF THE CHALCOGENS IN THE II–VI COMPOUNDS H. H. Woodbury and R. B. Hall p 27–64 refs (See N67-33431 19-26)
3. THE GALLIUM ARSENIDE THIN-FILM SWITCH DIODE J. R. Richardson p 65–75 refs (See N67-33432 19-09)

N67-33432# General Electric Co., Schenectady, N. Y. Research and Development Center, K-1.
THE GALLIUM ARSENIDE THIN-FILM SWITCHING DIODE
J. R. Richardson *In its* New Solid-State Device Concepts Dec. 1966 p 65–75 refs (See N67-33429 19-09)

The properties of gallium arsenide films made by flash evaporation were studied and compared with films made by the three temperature method. Switching and passive memory characteristics of the latter films were found to be distinctly superior. The unique properties of tellurium as a counterelectrode were established and are under further study. S.C.W.

N67-33466# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PARAMETRIC AMPLIFIER
Wu Wu 14 Mar. 1967 12 p Transl. into ENGLISH from Wu Hsien Tien (Communist China), no. 12, 1964 p 1–2
(FTD-HT-66-425; TT-67-62117; AD-653549) CFSTI: HC $3.00/MF $0.65

The paper discusses the fundamental theory and construction of parametric amplifiers. The power source of a parametric amplifier comes from a high-frequency oscillator. Variable parametric amplifiers with variable-capacitance p–n junction diodes have a lower noise figure than electron tube amplifiers. Capacitance of a p–n junction diode can be changed by varying the external voltage supply to the unit. The requirements of variable-capacitance parametric amplifiers are low quiescent capacitance, wide capacitance variation range, and high quality factor. Parametric amplifiers derive their pump power from an a.c. power supply unit. Theoretical studies and experiments verified that the frequency of a pump signal is several times higher than the frequency of an incoming signal, e.g., an incoming signal of 1000 mc may require a pump frequency of 10,000 mc or higher. The sum and difference are obtained by mixing the incoming signal frequency and pump frequency in a converting circuit. The converting circuit operates on the same principle as a superheterodyne receiver. Author points out that variable-inductance elements and special electron-beam tubes can also be used in parametric amplifier construction. Author (TAB)

N67-33475*# Electra Mfg. Co., Independence, Kans.
ACCELERATION FACTOR DETERMINATION FOR METAL FILM RESISTORS Final Report, 29 Jun. 1963–1 Mar. 1967
G. A. Swartz, W. O. Campbell, and W. E. Mc Lean 1 Mar. 1967 174 p refs
(Contract NAS8-11076)
(NASA-CR-87307) CSCL 09A

Studies were conducted to establish acceleration factors for determining the reliability of high stability metal film resistors, to determine modes of failure, and to establish process improvements and stress screening techniques for detecting the presence of the failure modes. Resistor parameters investigated included initial current noise and nonlinear distortion and deviations in resistance and current noise and nonlinear distortion due to applied stress. Metal film resistors from three separate manufacturers representing conformal coated, sealed ceramic sleeves and molded construction were tested. A preliminary sixteen cell matrix of power and temperature was designed to determine the most meaningful stress conditions to be used in extended life testing. Also, in order to determine methods of predicting potential failures, one-half of the resistors in each matrix cell were submitted to various screening techniques. A number of resistors were subjected to various conditions of power stress while the surface temperature was measured by means of the infrared radiation. Author

N67-33528# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
APPROXIMATION METHOD FOR FIRING WIRE-BRIDGE EED'S AT CONSTANT POWER
J. N. Ayres 3 Feb. 1967 27 p refs
(NOLTR-66-182; AD-650133) CFSTI: HC $3.00/MF $0.65

Even though its bridge resistance may vary widely an electro-explosive device (EED) can be fired under nearly constant-power conditions using a special power supply. The supply should have a source impedance equal to the geometric mean of the EEDs expected minimum and maximum resistance during firing. Electro-thermal parameter measurements and equations can be used to compute the optimum source impedance. Per cent regulation and error figures can also be computed. Author (TAB)

N67-33650# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PARALLEL AND IN SERIES CONNECTION OF TWO ELECTRONIC TUBES TO ONE LOAD WITH VARIABLE ANODE FEED
E. M. Reshetnikov *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 175–189 refs (See N67-33541 19-03)

A parallel and series connection of two electron tubes operating on the same load whose resistance cannot be changed is compared. Author

N67-33677# Utah Univ., Salt Lake City. Electrical Engineering Dept.
INVESTIGATION OF SYNCHRONOUS-WAVE R-F TO D-C CONVERSION Second Triennial Report, 1 Oct. 1966–31 Jan. 1967
D. C. Watson, K. I. Talbot, C. C. Johnson, and R. W. Grow Jun. 1967 25 p refs
(Contract DA-28-043-AMC-02290(E))
(UTEC-MD-67-008; Rept.-2; ECOM-02290-2; AD-654039) CFSTI: HC $3.00/MF $0.65

The investigation of cyclotron-synchronous wave r-f to d-c power conversion is continuing. Further analytical evaluation and preparation for experimental evaluation are reported. A Pierce-type electron gun and a 3GHz Cuccia cavity have been designed. A collector of low secondary-emission coefficient is being constructed. The electron gun and collector will be pretested in a gun-collector tester also being constructed. A simple analysis of the conversion problem assumes a discontinuity of the B sub z field at z = 0. This analysis predicts the asymptote values of conversion efficiency obtained in earlier computer solutions for short transition length. Another simple analysis, using results from a Hamilton-Jacobi investigation of the conversion problem, is given to show why the power converter is linear in operation as an a-c power supply, a result already obtained experimentally. The results of these analyses have indicated a definite direction for the experimental evaluation of the fourth tube. Both reversed-field conversion possibilities and a-c operation will be investigated when the new tube is ready for tests. Author (TAB)

N67-33814* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
MAGNETICS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 221–231 refs (See N67-33593 19-10)

A balanced magnetic structure consisting of two non-linear magnetic toroids was combined in a circuit with a linear capacitor to achieve a second-subharmonic buildup of capacitor voltage when pumped by a current pulse train. By utilizing the retentivity properties of the magnetic materials, the phase of the buildup can be controlled by application of a small steering current at any time prior to the pump sequence, and operation is achieved independent of the pump repetition rate. A mathematical model of operation is formulated, based upon experimental observation, providing insight into device operation, optimization and specification of required material properties. It is anticipated that this study will provide the background for the development of high speed bipolar magnetic sense amplifiers for use with computer memory systems. Author

N67-33816* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SEMI-CONDUCTORS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 232–239 refs (See N67-33593 19-10)
(Grant NGR-15-005-021)

Materials for semiconductors are examined in the light of recent engineering developments. The heterojunction interface is investigated in addition to the measurement of noise on germanium–silicon heterojunctions. Bistable switching niobium oxide diode research was conducted, together with a study on

high-frequency MOS (metal oxide semiconductor) field effect transistor. The step-recovery diode in experimental work is also mentioned. R.U.

N67-33616* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SOLID STATE ENERGY CONVERSION
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 240 (See N67-33593 19-10)

Materials for solid state energy conversion are examined in connection with a P–I–N photovoltaic energy converter. Abstracted technical data are presented on the impurities used to dope into the intrinsic germanium. It was found that Al for p-type and Au–Sb for n-type resulted in the best electrical characteristics. R.U.

N67-33617* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
THIN FILMS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 241–242 (See N67-33593 19-10)
(Contract N00163-66-C0096)

Failure mechanisms in thin-film resistors are presented in reference to various component materials. A preliminary study of the failure mechanisms of CdSe thin-film transistors is also provided. R.U.

N67-33627# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRON COMMUTATOR
V. S. Zhemov and Ye. P. Murashov 28 Feb. 1967 19 p refs Transl. into ENGLISH from Nauchn. Tekhn. Sb., Yadernoye Priborostr., no. 1, 1964 p 139–150
(FTD-HT-66-415; AD-653967) CFSTI: HC $3.00/MF $0.65

The development of a transistorized electronic switch is reported. The switch is intended for converting several slow-varying d-c voltages into proportional-amplitude pulses and combining these pulses for a common load. It is assumed that all N d-c voltage sources are independent and have an internal impedance of up to 100 kohms. The voltage may vary within 0.005–5 v. The switch comprises voltage-to-pulse converters K sub 1, K sub 2, K sub N, a clock-pulse generator G, a distributor that sends clock pulse to individual converters, and a matching circuit which combines the resulting pulses. An inverse-connected n-p-n Si transistor (P103) is used in the converter. The clock-pulse generator has a conventional blocking-generator circuit; its frequency varies by plus or minus 20% with temperature within -10 + 50C. The ferrite-transistor distributor circuit is equipped with a noise filter. The matching circuit includes a common-base stage and an emitter follower; the circuit was tested with 50 converters at -10 + 50C. Author (TAB)

N67-33687# Stanford Research Inst., Menlo Park, Calif.
HIGH RELIABILITY CONNECTIVE DEVICES Final Report, 1 Feb. 1964–31 Jul. 1966
Gunther Steinberg and Marvin Garrison Jun. 1967 164 p refs
(Contract DA-36-039-AMC-03727(E))
(ECOM-03727-F; FR-5; AD-653847) CFSTI: HC $3.00/MF $0.65

The study established that electrical contacts can be successfully lubricated with solid organic compounds. Octadecylamine hydrochloride (ODA.HCl) is capable of providing durable low friction sliding on gold and is regarded as a type of solid organic compound that has inherent lubricity, can be sheared easily, but has the ability to support a load. For good durability, the lubricant must be present in reservoirs in the surface of the contacts. A contact lubricant decreases friction and attendant wear, and maintains the integrity of a protective gold (or other previous metals) platings. Preservation of this plating prevents gross corrosion in sliding contact tracks. Several methods for application of the ODA.HCl to commercial contacts were tested and methods for identifying the presence of the lubricant film were developed. Author (TAB)

N67-33707*# Ion Physics Corp., Burlington, Mass.
STUDY OF UTILIZING ENERGY BEAMS IN THE FABRICATION OF SEMICONDUCTOR DEVICES Final Report
S. Harrison and R. Sudbury Jun. 1967 48 p refs
(Contract NAS8-20184)
(NASA-CR-87310) CSCL 09A

Methods of utilizing ion implantation techniques for producing semiconductor devices without the need for complex multi-step masking and photoresist-etch processing were studied. By the use of proper electrostatic or electromagnetic lenses, the ion beam from an accelerator can be focused and utilized to "write" with dopant ions in semiconductors, forming electrical devices. A 16-hole mask placed in the beam path has been successfully imaged with reduced magnification by a quadrupole lens system on a substrate about 3 meters away. A lens system and associated vacuum and electronic equipment were designed, constructed, and tested. The design energy range was 50 keV to 1 MeV with the lens generally operating with 80 to 100 keV ions. The lens system is electrostatic so that focusing is independent of ion species. A low-power secondary electron microscope was constructed inside the target chamber which ultimately gave a 30X magnified image of the spot being implanted, on a phosphor screen. A field effect device was made by scanning a single defocused beam from one heavily implanted area to a subsequent area that was then heavily implanted. The defocused beam was utilized to fabricate a device large enough to be easily contacted with probes. By electrically scanning the beams, an array of 16 FET structures with apparent edge resolution of better than 5 microns was written. Author

N67-33729# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
RESEARCH ON DISTRIBUTED FERRITES FOR CROSSED-FIELD MICROWAVE DEVICES Quarterly Report, 10 Nov. 1966–9 Feb. 1967
William A. Smith, Daniel Masse, John M. Osepchuk, Robert Plumridge, and Lawrence Tisdale May 1967 46 p
(Contract DA-28-043-AMC-02032(E); ARPA Order 679)
(ECOM-02032-4; QR-4; AD-653651) CFSTI: HC $3.00/MF $0.65

The objective of this program is to develop the knowledge and technology necessary to take full advantage of the unidirectional attenuative properties of ferrites in achieving improved gain and bandwidth in crossed-field microwave amplifiers and oscillators. During this fourth quarterly period, activities included further cold testing of ferrite materials in the L-band cold test vehicle and in the S-band QKS1267 Amplitron. A number of brazing experiments were carried out, and considerable effort was expended in the study of hot pressing techniques for the bonding of ferrites to alumina. The results were promising. The results of both theoretical and experimental studies of broadbanding have been encouraging. In particular, desirable properties have been demonstrated over half an octave in S-band with a porous manganese ferrite. The results of the first years work suggest that good rf performance is fairly easy to achieve but that the demonstration of these properties in an actual CFA must await solution of the technological problems of bonding and exposure of the ferrites the brazing conditions. The major aim of the second year will be the realization of hot tests at the earliest possible time. Author (TAB)

N67-33760# Hewlett-Packard Co., Palo Alto, Calif.
STEP RECOVERY DIODE FREQUENCY MULTIPLIER DESIGN
16 May 1967 28 p
(AN-913)

Step-by-step procedures for designing an impulse generator and related circuits that efficiently convert an input sinusoidal RF drive waveform into a sinusoid at microwave frequencies using step-recovery diodes in the shunt mode are presented. Examples describe design procedures for an X10 multiplier with an output of 2 watts at 2 GHz, an X5 multiplier with a 2 GHz output at 5 watts, and an X5 multiplier that achieves 10 GHz output at 180 mW. Graphs for finding optimum circuit components are included. Methods of matching the multiplier input and output impedances to source and load are described and techniques for compensating the circuit for temperature changes are discussed. The appendix includes a detailed discussion of the step-recovery diode and its use in harmonic generators and comb generators. A theory of operation of highly efficient harmonic generating and comb generating circuits is given along with experimental results and practical circuitry in the frequency ranges from 30 MHz to 300 MHz, 200 MHz to 2000 MHz, and 2 GHz to 10 GHz. R.N.A.

N67-33819# Argonne National Lab., Ill.
THRESHOLD SENSITIVITY OF TELEVISION CAMERA TUBES
Charles E. Cohn *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 178–179 refs (See N67-33781 19-14)

Consideration is given to the question of how far above system noise should the signal from an electron be. The answer is given in terms of the inherent noise component resulting from the randomness of the arrival of electrons. Also reported is an analytical treatment of noise generation in camera tubes. It is pointed out that the vidicon is less sensitive than the image orthicon by about a factor of 10 under the assumed conditions, and might be still less with practical vidicons and smaller quantum efficiencies. Results of studies indicate that with a sufficiently effective scintillator for 5 MeV electrons, the image orthicon should not need image intensification, nor should the vidicon if light collection is sufficiently good. M.G.J.

N67-33938*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE LINEARITY EVALUATION OF A DC VOLTAGE TO PULSE-WIDTH CONVERTER
Warren R. Crockett Jan. 1967 18 p refs
(NASA-TM-X-55656; X-711-67-11) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Test data are presented on the evaluation of the linearity and temperature stability of a linear analog dc voltage-to-pulse width converter, consisting of a combination complementary flip–flop circuit and constant current generator with a power drain of less than 100 milliwatts. Tabulations show the output pulse width in microseconds as the analog dc input voltage is varied over a range from zero to 5 volts dc. The method of least squares is used to derive the line equations that best represent these data. The maximum percentage deviation of the actual data from the least square line is determined for the operating range from 0.5 volts to 5 volts dc. The offset below 0.5 volts dc is discussed. Based on the results, it was concluded that the circuit linearity is relatively independent of temperature variations and that the slope of the transfer characteristic can be adjusted to minimize the zero offset by a relatively simple resistor adjustment. M.G.J.

N67-33976# General Electric Co., Owensboro, Ky. Tube Dept.
300 MILLIWATT X-BAND TRIODE OSCILLATOR Quarterly Report, 1 Jan.–1 Apr. 1967
J. M. Connelly and L. F. Jeffrey Jun. 1967 41 p ref
(Contract DA-28-043-AMC-01795(E))
(QR-5; ECOM-01795-5; AD-653846) CFSTI: HC $3.00/MF $0.65

Fifty Y-1613-E triodes were constructed for evaluation at X-Band. These Y-1613-E triodes have a heavier anode seal than the previously constructed triodes, and two versions were built: one version having grids with an interlaced support wire, and the other with support bar grids. A method for minimizing early life power output decay is described. Curves are given showing anode seal temperature versus anode dissipation. Performance curves show the difference in tuning range, with a representative sample of triodes, between a slot-coupled cavity oscillator and a similar unit using capacitive probe output coupling. The problems encountered in the slot-coupled version are discussed, and the reasons given for changing to a circuit using capacitive probe output coupling. Sketches of both types are included. Final life test results on the previously reported triode cavity oscillator are shown. Author (TAB)

N67-33978# Los Alamos Scientific Lab., N. Mex.
EVALUATION OF COAXIAL CABLE PERFORMANCE AT HIGH VOLTAGES Interim Report
G. P. Boicourt [1961] 21 p Presented at Symp. on Eng. Probl. of Controlled Thermonucl. Res., Gatlinburg, Tenn.
(Contract W-7405-ENG-36)
(LA-DC-8087; CONF-661016-33) CFSTI: HC $3.00/MF $0.65

Coaxial cables have been used extensively as high-voltage transmission lines between capacitor banks and experimental plasma loads. The large number of cables now being used at Los Alamos in the theta-pinch devices makes it imperative to obtain highly reliable, low-inductance, high-voltage cable. A program has been inaugurated to develop reliable 17/14 type, double-braided, low-inductance cable to operate at 50 to 85 kV. A test program has been initiated to establish criteria for evaluating cable designs and operating reliability. The first phases of the program are described. Three tests are used, two pulse discharge tests and a 60-Hz ac test. The first pulse discharge test used a 2-μF, 50-kV capacitor and spark gap to pulse charge a 0.1-μF capacitor through six cables being tested. This subjects the test cable to 57 kV at the 2-μF capacitor termination and to 78 kV at the 0.1-μF capacitor termination. The second pulse test uses six additional cables from the 0.1-μF capacitor to an open termination under oil. The open termination produces additional voltage on the second group of cables. The ac test is designed to subject 100 feet of cable to 60-Hz ac voltages up to 85-kV rms. The tests are described in detail, preliminary results are given, and the correlation between the pulse discharge tests and the steady state ac test is discussed. Author (NSA)

N67-33982# Sandia Corp., Albuquerque, N. Mex.
DESIGN AND PERFORMANCE CALCULATIONS OF MINIATURE DC MOTORS
F. S. Himebrook Apr. 1967 34 p refs
(Contract AT(29-1)-789)
(SC-TM-67-92) CFSTI: HC $3.00/MF $0.65

This memorandum represents one approach to the design of armatures for miniature dc motors. Theoretical and empirical methods are combined to reduce the cut-and-try activity and to minimize the overall effort required. Design of other motor parts, determinations of design constants, and performance calculations will be considered in subsequent memoranda. Author (NSA)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-32882# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THE THEORY OF INVARIANCE TO THE SELECTION OF THE PARAMETERS OF A FLIGHT CONTROL SYSTEM
V. A. Bodner and Yu. A. Ryazanov 2 Sep. 1966 16 p ref Transl. into ENGLISH of the book "Teoriya Invariantnosti v Sistemakh" Moscow, Izd. Nauk, 1962 p 403–411
(FTD-TT-651968; TT-67-60781; AD-652683) CFSTI: HC $3.00/MF $0.65

Effective inertial feedbacks of angular velocity in aircraft as control objects lead to the appearance of pairs of complex poles with small real negative parts and a negative zero. As a result of this the object becomes oscillatory with a small degree of damping in the presence of a large effect with respect to the derivative. The dynamic characteristics of the object can be improved by introducing a damping circuit, as a result of which, with selection of the appropriate transfer number of the damper, the inertial feedbacks in the object will be compensated. The closed circuit thus becomes invariant with respect to the variable parameters of the object. Realization of the conditions of invariance of the damping circuit is hampered by the presence of dynamic errors of the regulator elements. The reserve of stability is thus reduced and the possibilities of selecting the parameters of the control system are limited. The dynamic characteristics the system can be improved and the reserve of stability can be increased by reducing the dynamic errors of the elements and by the application of different control devices. As the parameters of the object change within wide limits, the conditions of invariance can be preserved by changing the transmission ratio of the damping circuit with the aid of self-adjusting devices. Author (TAB)

N67-32959 RAND Corp., Santa Monica, Calif.
AN APPLICATION OF SPECTRAL THEORY AND A GENERALIZED BIRTH AND DEATH PROCESS TO A RELIABILITY PROBLEM
Alan J. Gross and Donald J. Persico May 1967 23 p refs
(Contract DA-49-129-ENG-522)
(P-3594; AD-652681) CFSTI: HC $3.00/MF $0.65

The authors consider a system of electrical generating units that must produce a constant amount of power for a specified length of time T regardless of the number of units operating at any time t, where 0 < or = t < or = T. Such a system is called a load-sharing system, because whenever a component fails the remaining operating components share equally among themselves the power increase required of the operating components in order to sustain the power output of the system. In addition to the N operating units we assume there are x units in an active standby capacity for the system. If an operating or on-line unit should fail and a standby unit is available, the standby unit is switched instantaneously (with a certain probability) into operation. We also assume there is a repair facility which is available for the system. Thus, whenever a unit fails, be it an operating or standby unit, the failed unit enters the repair facility. The authors develop and solve in this paper the system of differential equations which describes the operation of the system and whose solution enables us to calculate the reliability of the system at any point in time. TAB

N67-33037# Wisconsin Univ., Madison. Dept. of Statistics.
ISN'T MY PROCESS TOO VARIABLE FOR EVOP?
George E. P. Box and Norman R. Draper Mar. 1967 13 p refs
(Contract Nonr-1202(17); Grant AF-AFOSR-1158-66)
(TR-106; AD-653266) CFSTI: HC $3.00/MF $0.65

In this paper this question is answered in the negative. First it is pointed out that large variability implies the existence of large effects waiting to be found. Second it is shown that an EVOP scheme which produces only a modest increase in the basic process variation can lead to detection of effects in a very few cycles. Author (TAB)

N67-33039*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMMAND PROCESSORS
D. E. Jamison Washington, NASA, Aug. 1967 33 p refs
(NASA-TN-D-4066) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Satellite activities and functions are controlled by transmission of commands from the earth. These commands are recorded at the time they are transmitted so they can be correlated with changes in satellite data when processing is performed. The command decoders process the standard commands used by GSFC for satellite control. The systems were developed for real time as well as post-operative processing of command data. Author

N67-33068# New York Univ., N. Y. Lab. for Electroscience Research.
TRANSFER FUNCTION SYNTHESIS USING RESONATORS AND SOME ACTIVE RC RESONATORS
John F. Oneil and Mohammed S. Ghausi Feb. 1967 85 p refs
(Contract AF 19(628)-5537)
(TR-400-154; SR-5; AFCRL-67-0130; AD-652502) CFSTI: HC $3.00/MF $0.65

A system for synthesis of transfer functions of complex frequency having simple finite poles with finite Q and arbitrary zeros is proposed. The method uses generalized four parameter resonators connected in parallel and imbedded in an operational amplifier configuration such that lattice type two path transmission takes place. The resonators may be admittances of, say, discrete elements, but emphasis is placed on the case of two-port resonators characterized by their short circuit transfer admittance. Active RC two-port resonators are developed using operational amplifiers. The two types required for general synthesis are sufficiently similar to permit building block type fabrication as integrated circuits using a single type of mask. The sensitivity of the resulting overall network to parameter errors and variations is calculated in general. The transmission sensitivity for a Butter-worth six-pole is calculated in detail as an example. Some aspects of the sensitivity of the active resonators are discussed. Experimental results verify that practical networks can be designed using the proposed system. Author (TAB)

N67-33098# California Univ., Berkeley. Lawrence Radiation Lab.
EXPERIMENTAL STUDIES OF THE OMNITRON ELECTRICAL COMPONENTS
James W. Davis, William L. Gagnon, and Bob H. Smith 3 Feb. 1967 12 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17252; CONF-670307-29) CFSTI: HC $3.00/MF $0.65

A prototype resonator has been built and is under study. It tunes from 6.8 to 33 MHz and is designed to produce an accelerating gap voltage of 60 kV at 20 Mc. Sixty 30-in.-diam by 1/2-in.-thick ferrite discs are used. The resonator is excited by a final amplifier using an RCA 4616 tube designed to deliver a peak RF power of 300 kW. Studies of the RF drive train and the master oscillator, which tunes continuously from 1.5 to 33 MHz are also discussed. It is a beat-frequency oscillator using a crystal-controlled fixed oscillator and a varactor-tuned variable oscillator. A ferrite magnet system, also under study, contains a coaxial, lumped-constant pulse line with a hydrogen thyratron switch tube coupled to a ferrite magnet. The pulse line uses ceramic capacitors and operates at one atmosphere of SF_6. The rise time is 100 ns, the pulse width 5 μsec, and the repetition rate 60 pps. Peak instantaneous power during the pulse is 200 MW; average power is 65 kW. Author (NSA)

N67-33155 Joint Publications Research Service, Washington, D. C.
CURRENT APPLICATION OF CYBERNETICS IN THE USSR
28 Jun. 1967 13 p Transl. into ENGLISH from the Russian Publ.
(JPRS-41598; TT-67-32231) CFSTI: HC $3.00

CONTENTS:

1. CYBERNETICS APPLICATIONS IN SPORTS TRAINING G. Yelenskij p 1–16 (See N67-33156 19-05)

2. AUTOMATIC DEVICE FOR PRODUCING MICROCIRCUITS V. Arkhipchuk p 7–8 (See N67-33157 19-09)

N67-33178# Little (Arthur D.), Inc., Cambridge, Mass.
CRYOTRON LOGIC STUDIES Final Report, 1 Jan. 1966–31 Dec. 1966
31 Jan. 1967 154 p refs
(C-67024; AD-652144) CFSTI: HC$3.00/MF$0.65

Research and development work is reported on a variety of cryotron problems including logical design of circuits, development of a photo-etching technique for constructing circuits, and techniques for interconnecting cryotrons on different substrates. Of particular interest was the construction of a logical network for squaring 10 bit binary numbers, having a capacity to give the 4 most significant places in the answer. This circuit contained 239 cryotrons on a 2 inch by 2 inch substrate and was constructed by a photo-etching technique. The second year of the contract was devoted to developing techniques for substrate interconnections. It was found that epoxy cement could be used to either bond glass substrates directly together or to bond a flexible mylar ribbon to the substrates. Circuits were constructed on a separate substrate and interconnected by evaporated superconductive lines across the epoxy bond. Further work on interconnection techniques was directed toward magnetic coupling of substrates by use of single turn transformers. The primary and secondary were constructed on separate substrates, with no ground plane under the transformer and with primary and secondary turns placed face to face with minimum separation. Very low inductance and excellent coupling were achieved. Author (TAB)

N67-33233*# Virginia Polytechnic Inst., Blacksburg.
EDUCATIONAL MONOGRAPH: AN EXAMPLE OF COMPENSATION NETWORK DESIGN PREPARED FROM WIDE BAND PHASE DISTORTION EQUALIZATION
L. L. Grigsby and W. A. Blackwell Stillwater, Oklahoma State Univ., Mar. 1967 16 p refs
(Contract NSR-37-002-045)
(NASA-CR-87279) CSCL 09C

An example of the design of a network to compensate for time-delay distortion introduced by a nonlinear phase vs. frequency characteristic is presented. The compensation network is a symmetrical lattice network and the design relations are developed by the use of image parameters. Author

N67-33234*# Virginia Polytechnic Inst., Blacksburg.
EDUCATIONAL MONOGRAPH PREPARED FROM CONTROLLER DESIGN FOR NONLINEAR AND TIME-VARYING PLANTS
H. F. Van Landingham and W. A. Blackwell Stillwater, Oklahoma State Univ., Mar. 1967 14 p refs Prepared for Oklahoma State Univ.
(Contract NSR-37-002-045)
(NASA-CR-87275) CSCL 09C

A technique to generate a control signal which forces the state of a nonlinear plant to be close to the state of a reference model is discussed. The method is suitable for a broad class of nonlinear plants. Special emphasis is placed on the time of response due to perturbations from equilibrium. Author

N67-33298# Illinois Univ., Urbana. Dept. of Electrical Engineering.
SOME GENERALIZATIONS IN SYSTEM THEORY AND THEIR APPLICATIONS TO CONTROL SYSTEMS
Sadanand Dinkar Agashe May 1967 135 p refs
(Contract DA-28-043-AMC-00073(E))
(R-356; AD-653524) CFSTI: HC$3.00/MF$0.65

Some definitions of the concepts state and state-deterministic system have been given by L. A. Zadeh and C. A. Desoer in their book Linear System Theory: The State Space Approach. In this thesis, using some of their ideas such as physical systems and their measurable attributes, a more fundamental definition of a system is given. Two new concepts, namely, functional dependence and quasi-functional dependence between attribute sets, are introduced, by means of which the concepts of output, input, and state, attribute sets are defined. Comparison of systems in two ways, in terms of their index sets and in terms of their attributes sets, is used to clarify the concepts of extensionally-state-determined and extensionally-state-stochastic systems. The concept of versatility of a system is next introduced to provide a third way of comparing two systems. It is shown that if a linear control system is less versatile than another, it is as versatile as the latter system provided with a suitable linear feedback and with the system matrix same as that of the first. Two theorems are proved regarding the versatility of linear free systems. A new perturbation process, called brief perturbation process here, which can be applied to control systems, is described in detail. Next, an interesting connection between uncontrollability and optimality is pointed out and the well-known sufficient conditions for controllability of a linear time-invariant control system are derived. Finally, a new definition of impulse response for linear as well as nonlinear control systems, using the concept of a brief perturbation process, is given. Author (TAB)

N67-33319*# Illinois Univ., Urbana. Dept. of Electrical Engineering.
SENSITIVITY REDUCTION USING OPTIMALLY DERIVED CONTROLLERS
James Phillip Horner May 1967 43 p refs Supported by NASA
(Contract DA-28-043-AMC-00073(E))
(NASA-CR-87363; R-353; AD-653522) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Feedback structures which reduce the parameter sensitivity of linear system are derived from the solution of the classical linear regulator problem. Linear, time varying systems with several inputs and outputs are treated, and simplifications in the design are noted for the time invariant case. Throughout the discussion, problems of implementation are considered as contraints on the design of the system. Specifically, unbounded elements in the controller are now allowable as the solution to be sensitivity problem. It is shown that for the structure, herein called Nth order feedback, the sensitivity of the system may be reduced to an arbitrarily small value. Author (TAB)

N67-33339 Royal Aircraft Establishment, Farnborough (England).
THE SYMMETRICAL OPTIMUM [DAS SYMMETRISCHE OPTIMUM]
C. Kessler Feb. 1967 33 p refs Transl. into ENGLISH from Regelungstechnik (Munich), v. 11–12, 1958 p 395–400, 432–438
(RAE-LIB-TRANS-1216)

Methods are given for the formulation of auxiliary functions which permit control engineering problems to be treated mathematically with greater simplicity. Considerations of symmetry lead to the formulation of an optimization method which makes possible a single parametric adjustment of the control loop. Author

N67-33383*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
DIRECT SYNTHESIS OF OPTIMAL LINEAR FILTER FROM CONDITIONAL PROBABILITY CONCEPTS

E. P. Cunningham *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Estimating the state of a randomly excited dynamical system from noise measurements having finite duration was investigated, and an optimal linear filter was directly synthesized from conditional probability theory. The optimal filter is obtained by expressing a Bayes estimate in closed loop form; and since the variance equations do not arise, it is possible to obtain an explicit expression for the gain matrix and to treat the random inputs with nonzero means. The mean vector enters in a natural manner into the model of the dynamical system in the filter; and there are two classes of problems characterized by random inputs and nonrandom inputs. The random-type gives rise to a two-point boundary problem in the calculus of variations, and in the nonrandom-type the maximization can be treated by ordinary calculus and results in a gain matrix. It is the latter method that can be applied to a maximum-likelihood estimate, which is defined as the mean of the conditional probability. M.W.R.

N67-33397* Tennessee Univ., Memphis. Dept. of Electrical Engineering.

SYNTHESIS OF MINIMAL SENSITIVITY SAMPLED-DATA CONTROL SYSTEMS

J. E. Bennett and J. C. Hung 30 Aug. 1967 30 p refs

(Grant NsG-351)

(NASA-CR-87321; SR-16) CSCL 09C

A frequency domain method of synthesizing the minimal sensitivity sampled-data control systems is developed. A minimal sensitivity system is the one having a shortest sensitivity polynomial. The method is simple, easy to apply, and is not restricted to the order of the plant. Several discussions are made. Three examples are given to demonstrate the effectiveness of the method. Author

N67-33455*# Arizona Univ., Tucson.

A DIGITAL COMPUTER PROGRAM FOR THE ANALYSIS AND DESIGN OF STATE VARIABLE FEEDBACK SYSTEMS

James L. Melsa Washington, NASA, Aug. 1967 52 p refs

(Contract NsG-490)

(NASA-CR-850) CFSTI: HC $3.00 CSCL 09C

This report discusses the development and use of a digital computer program for the analysis and design of linear state variable feedback systems. Because the program is based on the matrix formulation, it retains the generality and flexibility of this approach. The program has been successfully used on a large number of practical problems. Author

N67-33484*# Virginia Polytechnic Inst., Blacksburg.

EDUCATIONAL MONOGRAPH PREPARED FROM DESIGN OF TIME-WEIGHTED MINIMUM ENERGY DISCRETE-DATA CONTROL SYSTEMS

A. W. Bennett and W. A. Blackwell Mar. 1967 15 p refs See N65-16268

(Contract NSR-37-002-045)

(NASA-CR-87320; CS-6-67) CSCL 09C

A technique is discussed for the design of minimum energy discrete-data control systems. The "derived" matrix is used to determine the control sequence that will take the state of plant from some initial state to a desired final state in N sampling periods. The cost function stresses the controlling action of any part of the input sequence and relegates the remainder of the sequence to a supporting role. Author

N67-33542# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FUNDAMENTALS OF THE THEORY OF THE CALCULATION OF COMBINED CONTROL SYSTEMS

V. G. Terskov *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 3–46 refs (See N67-33541 19-03)

Problems related to the selection of a perturbation couplings operator and the calculation of its parameters in systems with combined control are considered. Author

N67-33543# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

QUESTIONS IN THE CALCULATION AND DESIGNING OF COMBINED CONTROL SYSTEMS

V. G. Terskov *In its* Elem. and Drives of Power Follow-Up Systems 13 Jan. 1967 p 47–80 refs (See N67-33541 19-03)

Questions related to the realization of the perturbation couplings operator, the influence of parameter deviations of the system, the action of interferences on the system, and the design of combined control systems are considered. Author

N67-33573# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.

THE CLOSED LOOP CHARACTERISTICS OF AN AUTOMATIC DIRECT READOUT IMPEDANCE BRIDGE Scientific Report

J. J. Ellis Mar. 1967 175 p refs

(Contract AF 19(628)-4050)

(SR-293(E); AFCRL-67-0180; AD-654012) CFSTI: HC $3.00/MF $0.65

The capabilities and limitations of an automatic complex impedance bridge were investigated. The bridge configuration selected as the most desirable for this effort is the inductively coupled ratio arms bridge. The operational characteristics of the bridge were studied in detail. In particular, relationships were developed relating the accuracy of the bridge measurements to the equivalent circuit of the bridge. The control mechanism for the balancing process was designed and simplified by exploiting the inherent characteristics of the bridge. A transformerless ratio arms bridge was proposed for high frequency applications where the inherent inductances of transformers might prove to be a factor limiting the accuracy of impedance measurements. The critical parameters of this bridge were also investigated in detail. Author (TAB)

N67-33574# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SYNTHESIS OF FLIGHT CONTROL SYSTEMS SUBJECT TO VEHICLE PARAMETER VARIATIONS Final Report, Jan. 1966–Jan. 1967

Eliezer Kreindler Wright-Patterson AFB Ohio. AF Flight Dyn. Lab., Apr. 1967 179 p refs

(Contract AF 33(615)-3411)

(AFFDL-TR-66-209; AD-653600) CFSTI: HC $3.00/MF $0.65

The main objective of this report is to investigate the potentials of adding sensitivity terms into the performance index to be optimized in order to achieve a reduction in sensitivity to plant parameter-deviations. The secondary objective is to survey the literature on methods of sensitivity reduction and on sensitivity in optimal control theory. Author (TAB)

N67-33593* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

[RESEARCH AREAS IN THE SCHOOL OF ELECTRICAL ENGINEERING OF PURDUE UNIVERSITY] Fifth Semiannual Research Summary, Jul.–Dec. 1966

Jan. 1967 331 p refs

(Contract N00016-66-C-0076-A04)

(NASA-CR-87048; AD-648495) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Summary data are presented on research projects covering medical and life sciences, control and information systems, electric

power systems and energy conversion, electromagnetic fields, electronic systems, materials, and agricultural remote sensing techniques. For individual titles, see N67-33594 through N67-33620. M.G.J.

N67-33596* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
OPTIMAL CONTROL THEORY
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 8–28 refs (See N67-33593 19-10)
(Grant NGR-15-005-021; Contract JPL-950670)

Electric engineering developments in optimal control theory and information systems cover such topics as: error in linear systems with bounded input; control of systems with inaccessible states; time optimal feedback control; minimum sensitivity optimal control; stochastic cooperative games; pursuit problem applied to synthesis of stochastic optimal controller; specific soft-lander control problem; and maneuverable landing in Martian atmosphere. R.L.I.

N67-33597* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
APPLICATIONS OF ADAPTIVE AND OPTIMAL CONTROL THEORY
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 29–30 refs (See N67-33593 19-10)
(Grant NGR-15-005-021)

For satellite tracking application, a general identification-control problem is investigated in two directions: the separation of identification and control functions, and the combination of identification and control functions in one control strategy. The objective is to develop overall optimal control strategies which simultaneously accomplish the identification and control functions. R.L.I.

N67-33598* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
STABILITY
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 31–33 refs (See N67-33593 19-10)
(Grant NGR-15-115-021)

A class of nonlinear systems having one singular point and a limit cycle was considered in the solution of the Zubor equation by the perturbation technique. A state space perturbation solution was formulated. Research is directed toward exploiting the full utility of the approach as to the number and types of nonlinearities which can be handled. Separate research was conducted on a second order nonlinear system having two stable singularities located symmetrically with respect to the origin and a saddle point at the origin. Interest is in developing a method for characterizing the global stability properties of this system. R.L.I.

N67-33599* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
DIGITAL SYSTEMS AND CODING THEORY
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 34–47 refs (See N67-33593 19-10)

Engineering developments are reported for digital systems and coding theory. The problem of compound threshold element synthesis of an arbitrary Boolean function from the Multi-threshold weight threshold vector (MTWTV) is considered. In another direction a sequential coding scheme for an additive noise gaussian channel was developed using a noisy feedback link and D-dimensional elementary signals having no band with constraint. Yet other research was directed toward exploiting the similarities and advantages of either a continuous-state system (differential system), or a discrete-state system, (e.g., automata or sequential machines). An investigation of the application of the potential function method as a learning technique is also briefly reported. R.L.I.

N67-33600* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
LEARNING SYSTEMS AND PATTERN RECOGNITION
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 48–61 refs (See N67-33593 19-10)
(Grant NSF GK-696)

Engineering developments in learning systems and pattern recognition are briefly reported. A simulation study was made on the relationships between subgoals and primary goals in a reinforcement learning control system. Independently from this, learning systems operating in unknown stationary environments were studied. The finite stopping rules and nonparametric techniques in a feature-ordered sequential recognition system were investigated. In addition, adaptive training sets for linear classifications were surveyed. R.L.I.

N67-33602* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
LONG RANGE RESEARCH
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 80–85 refs (See N67-33593 19-10)

Electromechanical energy conversion and electric power systems are briefly reported for long-range research programs. Engineering developments are reported on: extra large systems, extra high voltage systems, electrical transients in power systems, short circuits on untransposed networks, and measurement of turbo alternator transfer functions. R.L.I.

N67-33603* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
CO-ORDINATION AND SUPPORTING ACTIVITIES
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 85–86 (See N67-33593 19-10)

In application to electric power systems, the field of computer storage and retrieval of bibliographic data is very briefly surveyed. The PEREC bibliography is being updated and will include a dictionary of keywords. Computer programs and data files are also being developed to automate this storage and retrieval. R.L.I.

N67-33608* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ADAPTIVE AND LEARNING SYSTEMS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 120–142 refs (See N67-33593 19-10)
(Grant NSF GP-2898; Contract AF 33(615)-3768)

Communication systems technological developments are reported for adaptive and learning systems. Study areas include: parameter estimation with unknown symbol synchronization, unsupervised learning using moment estimators, analog implementation of an unsupervised learning communication system, distribution free–minimum conditional risk learning system, decision directed estimator for the source probability in a binary unsupervised learning system, and asymptotic probability of error using two decision directed estimators for two unknown mean vectors. R.L.I.

N67-33611* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
FUNDAMENTAL PROBLEMS OF CLASSES OF NETWORKS
In its [Res. Areas of the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 164–198 refs (See N67-33593 19-10)

Communication theory research and development in nonlinear circuits and systems is concentrated on fundamental problems of classes of networks. Briefly analyzed are: state variables, energy functions, and PR matrices; computer analysis and synthesis of nonlinear networks; frequency-domain stability conditions for linear networks containing time-varying resistors, inductors, and capacitors; frequency-domain criteria for the stability of nonlinear systems; negative resistance amplifiers with prescribed delay; transient

decay in nonlinear networks, and generation of constant resistance networks by topological methods. R.L.I.

N67-33612* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
NEW NETWORK ELEMENTS
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 199–216 refs (See N67-33593 19-10)

Nonlinear circuit and systems research is concentrated on some new network elements. A new network element reported is designated the scalor. Rotator frequency response is briefly described in its new aspect, and improved high power DC INIC for the rotator is highlighted. R.L.I.

N67-33613* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
PARAMETRIC AMPLIFIER STUDIES
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 217–220 refs (See N67-33593 19-10)

Nonlinear circuits and systems, with specific attention given to parametric amplifier studies, are summarily described. Phase-locked loop studies are delineated in addition to a new method for the determination of gain in parametric amplifiers. R.L.I.

N67-33619* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
PATTERN RECOGNITION
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 245–249 refs (See N67-33593 19-10)

Laboratory work on agricultural remote sensing is traced through pattern recognition application. Various data reduction schemes are currently being applied to spectrophotometer data obtained by reflectance measurements on the Beckman DK-2 spectrophotometer. Orthogonal data fitting scheme results are in application to statistical studies, also. Pattern classification performance both before and after data reduction is currently being investigated. R.L.I.

N67-33656# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
PUNCHED-TAPE READ-IN CIRCUIT IMPROVEMENTS FOR NUMERICAL CONTROL
K. B. Reedy 25 Apr. 1967 8 p
(Contract W-7405-ENG-26)
(Y-IA-44) CFSTI: HC $3.00/MF $0.65

Numerical control units applied to machine tools receive dimensional command information for coded perforated tape. Misalignment of the punched holes can occasionally result in loss of information which results in incorrect machine movements. A circuit which eliminates this possibility was designed and installed on a Bendix Dynapath 20 control unit. Author (NSA)

N67-33688# Yale Univ., New Haven, Conn. Dunham Lab.
SIMULTANEOUS MULTIPLE PARAMETER ADJUSTMENT IN ADAPTIVE SYSTEMS USING A SINGLE PERTURBATION SIGNAL
Kumpati S. Narendra and Theodore S. Baker 15 Apr. 1967 24 p refs
(Contract N0014-67-A-0097-0004)
(CT-11; AD-653474) CFSTI: HC $3.00/MF $0.65

A gradient method is presented for adjusting the parameters of a system to optimize a performance criterion. The partial derivatives of the performance index with respect to the adjustable parameters are obtained as real time signals, using a single perturbation signal for a system with unknown structure, but favorable topology. Computer simulations are included to indicate the feasibility of the approach. The adaptive control method using a single perturbation signal, as proposed here, has many features in common with the well-known parameter perturbation scheme. TAB

N67-33701*# Illinois Univ., Urbana. Charged Particle Research Lab.
ANALYTICAL AND EXPERIMENTAL STUDY OF POROUS METAL IONIZERS Final Report
A. Y. Cho and C. D. Hendricks 10 Apr. 1967 98 p refs
(Contract NAS3-8940)
(NASA-CR-72180; CPRL-8-67) CSCL 09C

The performance of porous tungsten ionizers were compared on the basis of transmission coefficient, neutral fraction, and critical temperature as a function of current density to determine which source had the highest efficiency of ionization. An electron beam welded source showed a higher neutral fraction than a 3.9 micron rhodium brazed source. After cleaning the electron beam welded source showed a lower neutral than the rhodium brazed one and less degradation as the current density increased. From this and the fact that the electron beam welded sources had twice the transmissivity of the rhodium brazed, it was concluded that there was further sintering during rhodium brazing. A low equivalent density special etched structure had the lowest neutral fraction for a given current density. The neutral fraction of 3.5 micron sources increased slower than that of 4.2 micron with increasing cesium ion density. The performance of 3.5 micron at 20 ma/cm^2 was superior to that of the 4.2 micron. The molecular current density effect in each pore can be traced to the relative collision probability between cesium molecules and between cesium and the tungsten walls of the pore. R.N.A.

N67-33808# Chicago Univ., Ill.
USE OF THE ELECTRO-OPTICAL EFFECT FOR REGULATION OF VOLTAGES
H. Stanley Bennett *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1968] p 137–138 ref (See N67-33781 19-14)

The problems anticipated in exploring the feasibility of the electro-optical effect for regulating voltages in an electron microscope are assessed. Advantages offered by use of this principle are cited as very high sensitivity to small voltage changes, with the possibility of detecting voltage variations of the order of one part in 10^8 or better. In the method proposed, a highly coherent monochromatic linearly polarized laser beam will be used as the basic information carrier; phase difference will be measured by a high accuracy polarimeter. It was concluded that a voltage regulator based on Kerr or Pockels cells, wherein the strains engendered in a dielectric medium modulate a polarized laser beam as to phase, offers attractive features. The high coherence of a laser beam and the sensitivity of a good polarimeter offer the possibilities of detecting voltage perturbations of 1 part in 10^7 or more. It is stressed, however, that several difficulties have to be overcome before the method can be recommended. M.G.J.

N67-33807# Cambridge Univ. (England).
INSULATION OF HIGH VOLTAGES IN VACUUM
William C. Nixon *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1968] p 139 refs (See N67-33781 19-14)

Based on previous experimental data on electrical breakdown in vacuum, the conclusion is reached that a cross magnetic field at the cathode surface of all electrodes in an accelerating tube, for instance, would prevent the field-emitted electrons from reaching the anode and so stop the chain reaction before it started. It is postulated that the magnitude of the magnetic field would be such that the emitted electrons of only a few volts at a short

distance from the surface would be bent back into the cathode. A small-scale experiment with a single pair of electrodes and an external electromagnet is suggested to produce evidence of any change in the breakdown potential with and without the crossed magnetic field. M.G.J.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-32714*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

ASSEMBLY/STERILIZER FACILITY FEASIBILITY PROGRAM, VOLUME I Final Report

21 Feb. 1967 96 p

(Contract NAS1-5381)

(NASA-CR-66439; Doc.-67SD604, Vol. I) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The assembly/sterilizer is an ultra-bioclean-room facility which allows decontamination and sterilization of a disassembled spacecraft, and subsequent assembly, checkout, adjustment, and if necessary, repair of the spacecraft in a sterile environment. All human operators are topologically and biologically isolated from the spacecraft after sterilization operations have been initiated. The collected data demonstrated the feasibility of the concept. Present-day aerospace hardware can be assembled under clean room conditions, decontaminated, sterilized, and still perform its designed function with no loss of response. Human operators can perform fairly complex assembly operations with little discomfort. The tools used in the program were limited only by their ability to withstand the sterilization cycles. All objectives relative to the bio-assay portion were successfully met. Large microbial populations were reduced significantly using ethylene oxide. All the cycles performed in the analog were successful, in that no living organism could be detected as having survived after assembly, insertion and/or repair subsequent to sterilization. Author

N67-33003# California Univ., Livermore. Lawrence Radiation Lab.

SYSTEM FOR GUIDING A RELATIVISTIC HIGH-CURRENT ELECTRON BEAM

William A. Sherwood 27 Feb. 1967 14 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967

(Contract W-7405-ENG-48)

(UCRL-70200; CONF-670307-25) CFSTI: HC $3.00/MF $0.65

A system now in use for guiding a 400 A, 4-MeV electron beam through the Astron linear induction accelerator is described. The guiding system elements consist of iron-shrouded and air core coils of special design. Hand calculations, measurements on experimental lenses, and design modifications indicated by on-line use have resulted in the evolvement, at modest cost, of reliable beam guiding elements capable of directing more than 400 A through the 40 foot length of the Astron accelerator. Unique features of the guiding system element controls are presented, and effects of these controls on accelerator beam parameters are discussed. Author (NSA)

N67-33238# California Univ., Berkeley. Lawrence Radiation Lab.

SECONDARY BEAM MAGNETS FOR THE 200-GeV ACCELERATOR: CONVENTIONAL OR SUPERCONDUCTING?

Robert B. Meuser 17 Feb. 1967 9 p Presented at the U. S. Natl. Particle Acceleration Conf., Washington, D. C., 1–3 Mar. 1967

(Contract W-7405-ENG-48)

(UCRL-17269; CONF-670307-31) CFSTI: HC $3.00/MF $0.65

To exploit fully the capabilities of the 200-BeV accelerator, many experimental beams must be set up concurrently, and many magnets will be required. The great stiffness of secondary-particle beams having momenta around 100 GeV/c requires long magnets to provide reasonable focal lengths and deflections. The result is a very expensive system of dc beam-transport magnets, and a large expenditure for electric power. Recent spectacular advances in the technology of superconducting (SC) magnets have led to considering the economics of replacing conventional magnets with equal numbers and kinds of SC magnets. The total capital-plus-operating costs of the two systems are discussed. NSA

N67-33247# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

IMPROVED EQUIPMENT ARRANGEMENTS FOR TRACON ROOMS Final Report

J. Roy Bradley, Jr. Apr. 1966 85 p

(RD-66-22; AD-653871) CFSTI: HC $3.00/MF $0.65

The report presents the results of a research project conducted to recommend environmental and hardware improvements for Terminal Radar Control (TRACON) Rooms. Through the use of laboratory techniques a simulated TRACON room was established to test environmental concepts and equipments. Field controllers opinions and recommendations, with those of the project members, were used as a basis for determining the advantages or disadvantages of particular equipments, their locations, and console modifications and configurations. Recommendations include: Operating position arrangement concepts; placement of auxiliary equipment and controls; improved lighting techniques and information display devices; and a new design for ATC TRACON room consoles. Author (TAB)

N67-33325# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

THE DAISY DECELERATOR

Richard F. Chandler May 1967 66 p refs

(ARL-TR-67-3; AD-653972) CFSTI: HC $3.00/MF $0.65

The Daisy Decelerator is a sled-track facility used for biodynamic and equipment impact testing. Since its first operational use in 1955, it has been developed to produce an impact force capability of up to 200,000 lbs (equivalent to 200 G for 1000 lb total weight), a maximum impact velocity of 175 ft/sec, and a maximum displacement during impact of 4 feet. Test sleds are available to carry one to three 250 lb test subjects in a variety of orientations relative to the impact force vector. These sleds are capable of accepting other payloads through simple adaptors. Propulsion of the sled is provided by a pneumatic piston device which accelerates the sled to the desired velocity over a distance of 42 feet. The sled is then released to coast into a waterbrake located further down the track. The waterbrake acts on the sled to provide the required impact test pulse. The water-brake force is controlled by pre-set orifices and can provide a variety of test pulse shapes limited only by the mechanical characteristics of the system. Tests have demonstrated velocity reproduced with a standard deviation of 1.6%, and deceleration reproduced with a standard deviation of 3.5%. Author (TAB)

N67-33334# California Univ., Berkeley. Lawrence Radiation Lab.

USE OF ALUMINUM COILS INSTEAD OF COPPER COILS IN ACCELERATOR MAGNET SYSTEMS

Michael A. Green 24 Feb. 1967 15 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C., 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17258; CONF-670307-38) CFSTI: HC $3.00/MF $0.65

Use of aluminum windings for the ac injector-synchrotron and dc storage ring magnet systems has been studied. The injector synchrotron is an 18-Hz fast-cycling 8-GeV accelerator that feeds protons to the 200-GeV main ring. The physical properties of aluminum are discussed, as are the extrusion of the conductor and the winding of the coils. Also included is a discussion of cooling-system problems and their solution. Important design conditions for aluminum coils are given. An economic analysis of aluminum- and copper-coiled magnet systems is presented. As an example, the injector-synchrotron magnet system is compared to a dc storage-ring magnet system with the same magnetic characteristics. The optimum coil current density is discussed, as are the effect of gap field, economic life, and core shape on cost and optimum current density. Physical and economic advantages of aluminum coils for magnet systems are presented as are conditions under which the use of aluminum coils should be avoided.
Author (NSA)

N67-33335# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
RECENT PROGRESS IN THE O.N.E.R.A. HOT-SHOT WIND-TUNNELS [PROGRES RECENTS DANS LES SOUFFLERIES A ARC DE L'O.N.E.R.A.]
Pierre Carriere and Jean-Pierre Chevallier 1967 54 p refs In ENGLISH and FRENCH Presented at 5th Symp. on Hypervelocity Tech., Denver, 16–17 Mar. 1967
(ONERA-TP-447(1967)) CFSTI: HC $3.00/MF $0.65

After a brief survey of hot-shot wind-tunnels, a new layout of the arc chamber is described, which includes an intermediary chamber between the arc and the nozzle. Thanks to that new design, good results have been obtained: stability and homogeneity of the flow, repeatability of the generating conditions, level of accessible temperature, and pollution. On the other hand certain devices are described which permitted the enhancement of the efficiency of the facility (variation of incidence during the run, or rotation of the model around its axis). New measuring techniques were also developed: measurement of the skin friction and measurement of the electromagnetic field of the plasma or in its wake. The descriptions are illustrated by typical examples of measurements, giving the opportunity to appreciate the quality of the results attained and the work that is still to be done.
Author (ESRO)

N67-33347# Texas A&M Research Foundation, College Station.
A STUDY TO IMPROVE THE LOW-LEVEL METEOROLOGICAL SIMULATOR Semiannual Report, 15 May 1966–15 Jan. 1967
William H. Clayton and Tom E. Sanford May 1967 33 p refs
(Contract DA-28-043-AMC-02286(E))
(Rept.-1; SAR-1; ECOM-02286-1; AD-653644) CFSTI: HC $3.00/MF $0.65

The first part of a digital preparation format to provide necessary processing of raw data to a form suitable for General Purpose Analog Computer solution in the Low Level Meteorological Model has been completed. This format has been employed to verify the manual procedures followed in the derivation of the eleven test cases on which the evaluation and refinement procedures of the Low Level Meteorological Model have been based to date. Case studies of the Low Level Meteorological Model have shown that the profile equations for wind, temperature, and vapor pressure are inadequate and replacement relationships have been derived. Computational verification of the new relationships are reviewed.
Author (TAB)

N67-33506# Los Alamos Scientific Lab., N. Mex.
RADIATION LEVELS AT THE LOS ALAMOS TANDEM ACCELERATOR FACILITY
Morris J. Engelke, Thomas P. Seitz, and Richard L. Henkel 10 Apr. 1967 29 p refs
(Contract W-7405-ENG-36)
(LA-3641) CFSTI: HC $3.00/MF $0.65

Radiation surveys were made of the Los Alamos tandem accelerator facility. The radiation levels of primary concern for health and safety were the γ radiation levels at the vertical accelerator and neutron levels around the tandem accelerator and at the control slits and target. Gamma radiation of over 4,000 R/hr was found, and neutron levels were found greater than 25 Rem/hr. These measurements were made inside the biological shield; no detectable radiation was found in areas of normal occupancy.
Author (NSA)

N67-33520# Aeronautical Research Inst. of Sweden, Stockholm.
DOUBLE-DRIVER SHOCK TUBE FOR SHOCK-ON-SHOCK SIMULATION
Bo Lemcke Dec. 1966 90 p refs
(FFA-109) CFSTI: HC $3.00/MF $0.65

A novel device for experimental studies of the shock-on-shock interaction on bodies in supersonic flow has been developed. The method utilizes a single shock tube for generating the pre-blast flow as well as the blast shock. The model is stationary during the tests, thus making it possible to take full advantage of all the instrumentation techniques available for shock tube work. The theoretical performance of the device has been analyzed in some detail and the parameters for controlling the flow have been found in connection with specially designed experiments. An important result of the analyses is the fact that an optimum loading set-up has been found that gives the strongest possible blast shock for given pre-blast flow conditions. Two experimental programs have been carried out to study both the performance of the device and its applications to shock-on-shock interactions on wedges and hemispheres.
Author

N67-33641# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
IONIZED-WAKE INVESTIGATION IN HOT-SHOT WIND-TUNNELS [UTILISATION DES SOUFFLERIES A ARC BREF POUR L'ETUDE DES SILLAGES IONISES]
Jacques Dorey and Didier Compard 1967 34 p refs In FRENCH; ENGLISH summary Presented at the AGARD Meeting on Plasmas in Wakes, Fort Collins, Colo., 10–12 May 1967
(ONERA-TP-455(1967)) CFSTI: HC $3.00/MF $0.65

The experimental devices used for investigating locally the characteristics of ionized near-wakes are described. The models are released in a hypersonic flow of nitrogen at Mach 16. Electrostatic triple-probes give the possibility of determining the electronic temperature and density. The first results indicate a tubular structure of the plasma presenting a minimum of electronic density on the axis of the model. The electronic temperature increases regularly from the base to the last point of measurement downstream. Seeding tests are described. The insemination of electro-negative gas (SF_6) in the shock-layer is carried out either by means of the gas in the arc chamber or by means of an injector placed inside the model; the results obtained are described. Following this first series of tests, it appears that the hot-shot wind tunnel is well adapted to the investigation of the ionized wakes of large-size models.
Author (ESRO)

N67-33643# European Space Technology Center, Noordwijk (Netherlands).
APPLICATION OF GEBHART'S METHOD TO THE COMPUTATION OF RADIATIVE EXCHANGES INSIDE AN ENVIRONMENTAL CHAMBER [APPLICATION DE LA METHODE DE GEBHART AU CALCUL DES ECHANGES RADIATITS A L'INTERIEUR D'UNE CHAMBRE D'ESSAIS]

L. Toussaint and A. Taroni Paris, ESRO, Apr. 1967 63 p refs In FRENCH; ENGLISH summary
(ESRO-TN-13) CFSTI: HC $3.00/MF $0.65

The object of the present investigation is to evaluate the quantity of energy absorbed by the outer surface of a satellite exposed to the radiation of a solar simulator inside a vacuum chamber. No conduction heat exchange is considered. An attempt is made to calculate the effect of the reflections from the shroud by the application of Gebhart's method. The computation is carried out for a particular case: the satellite is the ESRO I satellite (near-cylindrical shape); the chamber is the HBF 2 chamber (ESTEC Noordwijk); the solar simulator consists of five carbon-arc lamps. Author (ESRO)

N67-33723# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
FOG DISPERSAL EXPERIMENTS USING PROPANE AT WALLA WALLA, WASHINGTON
J. R. Hicks Apr. 1967 18 p refs
(CRREL-TR-189; AD-653636) CFSTI: HC $3.00/MF $0.65

Propane is an effective agent causing glaciation of supercooled fog droplets and subsequent improvement of visibility. When wind is less than 5 or 6 knots and steady with respect to direction, two or three dispensers, each emitting 2.5 to 3 lb/min. of liquid propane, could probably keep an airfield open to air traffic at a cost of about 20 dollars per hour. The propane system is easy to use, inexpensive, requires neither preparation nor personnel standby time after the initial installation, and is effective at temperatures higher than the effective temperature of the more commonly used agents. No combustible mixture has been found beyond 8 ft from the discharge nozzle of the propane-air mixture. On airports with short runways, the reduced aircraft braking index caused by snow accumulation might be sufficient to render the system unsuitable unless the dispensers could be positioned far enough from the airport to allow the snow to fall upwind of the runway. TAB

N67-33736# Uppsala Univ. (Sweden). Inst. of Physics.
A SPECIAL GLOVE BOX FOR PREPARATION OF Th–B SOURCES
Curt Bergman Jan. 1967 10 p refs
(UUIP-517)

A glove box, constructed with special consideration for protection from gaseous daughter activities of ^{228}Th and from gamma radiation, is described. It is shown that the accelerating voltage should not be higher than 500 V and that the source geometry has an important effect on the source strength and the shape of the thorium A-line. Author (NSA)

N67-33782# Northwestern Univ., Evanston, Ill.
THE GENERATION OF HIGH VOLTAGES
Ernest D. Klema *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 1–7 (See N67-33781 19-14)

Consideration is given to the specific problem of furnishing a source of electrons for a microscope, of from 0.5 to 5.0 MeV, which would be stabilized in energy to the order of one part in 10^6 of suitable optical quality, and with an on–off switch device. Five possible sources of high voltage generators were compared, and the compatibility of these generators with several methods used for high voltage stabilization are summarized. Particular attention was given to the possibilities of the linear accelerators (Linac), and to developmental work being conducted to achieve a high intensity beam. It is suggested that serious thought be given to charging up a high voltage electrode with 6 MeV electrons with a continuously operating, room temperature Linac. The main advantage is cited as permitting the optics of the beam to be separated from the optics of acceleration. The feasibility of producing an electron microscope beam directly by means of a Linac is assessed, and diagrams are included to depict a possible layout for a Linac gun system and a proposed superconducting electron microscope. M.G.J.

N67-33783# Wisconsin Univ., Madison.
ACCELERATOR TUBE DESIGN
John M. Donhowe *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 8–10 (See N67-33781 19-14)

An overview is presented on the development of accelerating tubes with maintenance of high gradients and a nominally uniform field. These include (1) an accelerating tube with potential distribution, (2) field emission tip immersed in a uniform field as a means of distributing the potential along the axis during injection, and minimizing the spherical aberration for a given set of conditions; and (3) axial potential distribution in an accelerating tube. Also discussed are the performance characteristics of orbitron pumps, which gave evidence of being capable of maintaining an ultimate pressure below 1×10^{-11} torr. It is reported that 20-cm pump operated at 200 watts and maintained a pressure of 6×10^{-8} torr in the electrostatic analyzer vacuum box for over 6 months without service; the 7.6-cm target chamber pump operated at 50 watts for periods of one to two months without service. M.G.J.

N67-33784# Wisconsin Univ., Madison.
STABILIZATION OF THE HIGH-VOLTAGE GENERATOR
John M. Donhowe *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 13–18 ref (See N67-33781 19-14)

A high precision resistive voltage divider and a magnetic spectrometer are assessed as a means of analyzing and controlling the high voltage beam. Laboratory experiments are discussed briefly, in which resistive voltage dividers were used in an attempt to measure the stability of high voltage proton beams. Findings indicate the difficulty in achieving stabilization to better than 1 ppm unless the problem of thermal fluctuation could be solved. The magnetic spectrometer is based on the principle of semicircular focusing of electrons passed through a uniform magnetic field, with the electron beam directed into a uniform magnetic field in a direction perpendicular to the field, and then deflected in the field in the arc of a circle. A difficulty with this device, as applied to an electron microscope, is considered to be the required homogeneity of the magnetic field. Mention is made of three means suggested for voltage stabilization: the Pradal monochromator, a high-Q cavity serving as an electrometer, and electro-optical effects for voltage regulation. M.G.J.

N67-33785# Argonne National Lab., Ill.
REMARKS ON ELECTRON-GUN AND ACCELERATING-TUBE DESIGN
James W. Butler *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 19–21 refs (See N67-33781 19-14)

Discussion is centered on the approaches taken to the basic problem of designing an electron gun with aberrations as low as possible; in other words, of designing an electrostatic accelerator capable of producing 50 to 100 kV electrons while maintaining the beam quality at a level comparable to the high quality available from the field emission source. An analytic procedure is outlined with the potential function along the axis as input; both the paraxial trajectories and the required electrode shape are determined from this input. Equations are derived to produce a computer code to perform the necessary calculations. Studies on accelerating columns led to the suggestion of considering a column made up of a stack of lenses similar in design to the already developed electron gun. It is reported that the lens design programs were incorporated as subroutines into a program which performs calculations for all lenses in the stack and combines the results into one effective lens. M.G.J.

N67-33796# Argonne National Lab., Ill.
PROPOSED LAYOUT OF AN ELECTRON-MICROSCOPE FACILITY
John W. Robinson *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 100-104 (See N67-33781 19-14)

A conceptual drawing is presented to show the suggested location of the microscope facility at Argonne National Laboratory. Detailed floor plans are provided for the conventional microscopy and support building, and the equipment building, and high voltage microscope building. The problems involved in selecting the site are discussed, along with the considerations which influenced the proposed designs. M.G.J.

N67-33797# Argonne National Lab., Ill.
STRUCTURAL CONSIDERATIONS FOR AN ELECTRON-MICROSCOPE FACILITY
William R. Riordan *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 105-107 (See N67-33781 19-14)

The main structural problem associated with designing an electron microscope facility is identified as the isolation of the high voltage microscope column from vibration. To minimize this problem, the proposed facility is split into three buildings to house the high voltage microscope, the conventional microscopes and preparation area, and the mechanical and electrical equipment. It is pointed out that a necessary design criterion will be to determine what displacements can be tolerated by the microscope and the accelerator, and that readings of the site, over a range of frequencies, are needed to find out how much displacement would have to be eliminated to keep the microscope within the limits set. Suspension methods for reducing vibration are discussed. Vibration measurements, made in three existing buildings, show that the magnet ring base of ZGS is, with the exception of the building housing, extremely free of vibration. Commercial electron microscopes installed without vibration mounts are adversely affected by building vibrations; those with vibration mountings are virtually free of it. M.G.J.

N67-33798# Argonne National Lab., Ill.
MECHANICAL DESIGN CONCEPTS FOR AN ELECTRON-MICROSCOPE FACILITY
Paul R. Hirsch *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 108-109 (See N67-33781 19-14)

Schematics are presented to show the location of the heating, ventilation, air conditioning, and plumbing systems, and the process systems needed to serve the equipment located in the building. Tunnels connect the equipment building with the high voltage microscope and conventional microscope and support buildings. Because of the vibration problem, all mechanical equipment will be located in the equipment building with special design consideration to reduce transmission of vibrations through the piping, and to reduce transmission from rotating equipment to the equipment room floor. The process equipment, located as close as possible to the high voltage microscope building, is dependent upon the type of electron microscope lens and high voltage generator finally selected. It might include liquid helium regeneration system, liquid nitrogen regeneration system, equipment for cooling, purifying, transferring, and storing the insulating gas used in high voltage accelerator tanks, rough vacuum systems, and low conductivity water equipment. M.G.J.

N67-33799# Argonne National Lab., Ill.
ELECTRICAL DESIGN CONSIDERATIONS FOR AN ELECTRON-MICROSCOPE FACILITY
Henry Kacinskas *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 110-111 (See N67-33781 19-14)

A simplified diagram is presented on the proposed electric power supply system which will use the Laboratory's existing 13 kV network. An aerial line is planned to bring the power to a point approximately 200 feet from the facility, where an underground conduit is proposed to provide substantial shielding. In the equipment building, the 13 kV power will be stepped down by two transformers for distribution within the facility. A diesel-driven emergency generator is also proposed which, upon sensing the loss of the normal power supply, would start up automatically and in 10 to 15 seconds be able to assume loads from the emergency power bus. Grounding system requirements are discussed, and the recommendation is made that a suitable means be provided to disconnect the ground electrode system for periodical tests. M.G.J.

N67-33800# Cambridge Univ. (England).
PROPOSAL FOR A SUPER-HIGH-VOLTAGE ELECTRON-MICROSCOPE FACILITY
K. C. A. Smith *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 112-116 (See N67-33781 19-14)

Experimental flexibility is cited as the essential requirement of a superhigh voltage electron microscope facility, with an instrument that will allow the testing and development of new components and methods while permitting a research program to be carried on with a minimum of interruption. In the proposals discussed, provision is made for, ultimately, two instruments which may be operated separately or together without mutual interference. The initial instrument would be of relatively conventional design permitting rapid modification to allow testing of new lenses and other components. The second instrument would be developed from the experiences gained with the initial instrument and from the innovation of new techniques. Two suggested layouts for the facility building are depicted. One comprises a two-story building, with the upper floor accommodating the high voltage generating and accelerating equipment, and the lower story containing the microscope columns. A pit or basement below each column would facilitate the removal and/or transport of complete columns or sections of columns. The other is a silo-type construction for one column which is down in the ground, with the structure supporting the high voltage and completely independent of it. M.G.J.

N67-33801# Wisconsin Univ., Madison.
APERTURE ABERRATIONS OF AN ACCELERATING TUBE WITH A SECTION OF UNIFORM FIELD
Ronald W. Moses, Jr. *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 118-123 refs (See N67-33781 19-14)

Several examples are given to demonstrate techniques for analyzing aperture aberrations of a collimator-uniform field condenser type of accelerating system. Interest is centered on accelerating electrons to 5 MeV, and focusing the beam into a probe spot size of about 1 Å. It is assumed that this is an electrostatic accelerating tube which forms a beam of 5 MeV electrons into trajectories nearly parallel to the beam axis, and that there is a magnetic condensing lens which focuses the beam to a spot. Beam trajectories in various sections of the acceleration tube, and from virtual object and virtual image are calculated and plotted. Equations are derived to obtain the aperture-aberration coefficients. Also considered is a slightly nonuniform field near the source, which focuses the electrons into a parallel beam without trajectories that cross the axis. M.G.J.

N67-33804# Reading Univ. (England).
THE BRIGHTNESS OF A LINEAR ACCELERATOR USED AS AN ELECTRON-MICROSCOPE SOURCE
T. B. Rymer *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 132-133 *ref* (See N67-33781 19-14)

A general theorem of electron optics is stated, and formulas for brightness are derived for conventional microscope beams and for the linear accelerator. Previous data on the brightness of the Stanford 2-mile linear accelerator test injector are discussed. It is shown that the figure can be materially improved by accepting only half the beam. M.G.J.

N67-33805# Illinois Univ., Urbana.
SEPARATED HIGH-VOLTAGE CHARGING AND ACCELERATING SYSTEMS
A. O. Hansen *in* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 134–136 refs (See N67-33781 19-14)

Some important properties of several charging systems are discussed. These include the conventional, single electrode Van de Graaff, the Van de Graaff with separated but adjacent charging and accelerating electrodes, the Cockroft–Walton and dynamitron charging systems, pulsed electron Linacs, conventional Cockcroft–Walton Linacs, and superconducting Cockcroft–Walton Linacs. The use of separated but adjacent charging and accelerating electrodes in the same pressure tank is also considered as a method of supplying charging currents for voltage control much larger than the average current carried up by the charging system. Author

N67-33868# Advisory Group for Aeronautical Research and Development, Paris (France).
VON KARMAN INSTITUTE (1956–1966)
Oct. 1966 15 p refs *Its* NATO Letter

Research being conducted at the Von Karman Institute in subsonic, supersonic, and hypersonic flow fields, high speed in high pressure atmosphere, and turbomachines is discussed. Future prospects for research at the institute are briefly mentioned. Photographs and descriptions of the institute's wind tunnels and turbomachinery are included. R.N.A.

N67-33888# Los Alamos Scientific Lab., N. Mex.
THE ENGINEERING ASPECTS OF THE LASL SCYLLAC PROPOSAL
E. L. Kemp [1961] 33 p refs Presented at Symp. on Eng. Probl. of Controlled Thermonucl. Res., Gatlinburg, Tenn.
(Contract W-7405-ENG-36)
(LA-DC-8086; CONF-661016-35) CFSTI: HC $3.00/MF $0.65

Scyllac is a proposed toroidal theta-pinch machine to be built at the Los Alamos Scientific Laboratory. The major diameter is 15 meters, minor diameter 10 cm. The primary capacitor bank will store 10 MJ at 60 kV and deliver 134 MA with a rise time of 3.8 μsec. The system will also include a preionization bank, 130 kJ at 40 kV, a quadrupole stabilization bank, 2 MJ at 60 kV, a mirror stabilization bank, 2 MJ at 60 kV, and a bias field bank, 2 MJ at 10 kV. All banks will be crowbarred. The machine will look like a segmented washer in plan view with the load coil on the inside radius. Each segment will consist of two 2 in. aluminum alloy current collector plates held together with insulated through-bolts. The bolts will be incorporated into a cartridge that serves as a cable termination for 12-load cables. The design features of the collector system and the cable cartridge will be discussed. Scyllac will require a new 2-μF, 60-kV capacitor, reliable high-voltage, low-inductance coaxial cable, new 4-element start spark gaps and crowbar gaps. These components are under active development and the status of each will be presented. The system design philosophy will be discussed. Author (NSA)

N67-33915# Arctic Aeromedical Lab., Fort Wainwright, Alaska.
ARCTIC FIELD TEST OF PORTABLE FOAMCORE SHELTER
John F. Roy Mar. 1967 36 p
(AAL-TR-66-14; AD-653179) CFSTI: HC $3.00/MF $0.65

A lightweight portable 16 x 32 ft foamcore shelter was tested in a cold environment to determine its adequacy and potential use in an arctic environment. The Quonset-shaped structure had a foundation frame of aluminum grade beam sections fastened together with connector bolts. Panel construction was a composite of 1/4-in. thick polystyrene foam with a paper liner laminated to each side and painted with a resin-type coating. Velcro material fastened together the arches and end panels. Flooring was a synthetic tarpaulin. One-inch thick urethane foam panels provided additional insulation. The shelter was anchored with grade beam stakes and tie-down ropes. To provide temperature measurements the shelter was instrumented with copper-constantan thermocouples and thermistor probes. Test results showed the test item was a suitable general-purpose shelter for arctic use and capable of a continuous period of use or several assembly-disassembly cycles. It did not seem advantageous for use in field maneuvers where frequent movement of the structure would be necessary. If the shelter were to be used extensively in the arctic, suggested priority design modifications include: Redesign the entrance to provide a vestibule or double door for better thermal protection; use a structural floor or a flooring material that remains flexible at -40F; incorporate a suitable auxiliary insulation system; and improve the ventilation system. TAB

N67-33930# Sandia Corp., Albuquerque, N. Mex.
SHOCK SIMULATION
R. O. Brooks Apr. 1967 21 p Presented at the Inst. of Environ. Sci. Meeting, Winter Park, Fla. Submitted for publication
(Contract AT(29-1)-789)
(SC-DC-67-1630; CONF-670412-1) CFSTI: HC $3.00/MF $0.65

Test equipment was devised to simulate impact shock conditions and to subject small component test specimens to controlled, reproducible shocks. Instrumentation for measuring the effects of shock are described. NSA

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-32707# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF THE SHAPE AND NOTION OF AN ARC DISCHARGE IN A TRANSVERSE MAGNETIC FIELD
William H. Dement (M.S. Thesis) Jun. 1967 92 p refs
(GSP/PH/67-3; AD-652482) CFSTI: HC $3.00/MF $0.65

The report presents the results of an experimental investigation of the shape and motion assumed by an electric arc discharge in a transverse magnetic field. The experiments were performed on a direct current arc discharge in an argon environment at sub-atmospheric pressures. Photographic data, both still and high-speed motion picture, were obtained. The arc shape from a thermionically emitting tungsten cathode was observed for various values of magnetic induction, pressures, electrode separations, and arc currents. The rotational velocity of an arc between two concentric copper ring electrodes was measured for various magnetic inductions, pressure, and electrode separation distances. The results obtained were in general agreement with the magnetic pumping theory of retrograde arc motion. Author (TAB)

N67-32760# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
CONDENSATION DROPLET GROWTH IN RAREFIED GASES
Sang-Wook Kang Wright-Patterson AFB, Ohio: ARL Mar. 1967 43 p refs

(Contract AF 33(657)-8302)
(ARL-67-0049; AD-653199) CFSTI: HC $3.00/MF $0.65

An analysis is made of thermal and diffusion effects on the droplet growth phenomena in a supersaturated vapor and inert carrier gas (see also AD-646 669). Two cases are considered: 1) constant fluid conditions, and 2) changing fluid conditions due to condensation effects. The analysis is so formulated as to describe the continuous growth process as the droplet size increases from microscopic (free-molecular) to rarefied, even to macroscopic (continuum). Equations for the conservation of mass and energy are derived by application of the Langmuir model in the rarefied (slip) regime and two correlation parameters for the mass transfer and the energy transfer are introduced for analyzing this regime. Analytic solutions are obtained for the droplet growth with time by expressing the saturation vapor pressure as a linear function of temperature. The results indicate that the choice of these slip-regime parameters influence the droplet growth only when the ratio of the droplet size to the mean free path is of order one. However, when the droplet size is very small or very large compared to the mean free path, the values chosen for these parameters have a negligible effect on the droplet growth. Author (TAB)

N67-32751# Hydronautics, Inc., Laurel, Md.
HYDRODYNAMIC ASPECTS OF MACROMOLECULAR SOLUTIONS
Marshall P. Tulin May 1967 38 p refs
(Contract Nonr-4181(00))
(TR-353-4; AD-653097) CFSTI: HC $3.00/MF $0.65

The report is an attempt in very brief form to: review some important concepts involving disperse systems (such as thermal forces, entropy, and strain energy); discuss the dynamics of molecular response to the motion of the solvent; introduce and discuss the idea of critical strain rates, which arises naturally in the theory of molecular response; relate molecular strain to fluid stresses through the use of Mohrs Circle; discuss in a speculative way the role of fluid stiffness in turbulent flows, as for example in providing a mode for the extraction of turbulent energy from an eddy through the generation of elastic shear waves. Finally, it is speculated how the possibility for radiation damping may result in a two or three-fold thickening of the viscous sub-layer. Author (TAB)

N67-32792# Hydronautics, Inc., Laurel, Md.
THEORY OF EROSION
A. Thiruvengadam Mar. 1967 53 p refs
(Contract Nonr-3755(00)(FBM))
(TR-233-11; AD-652385) CFSTI: HC $3.00/MF $0.65

An elementary theory of erosion is derived based on the assumptions of accumulation and attenuation of the energies of impact causing erosion. This theory quantitatively predicts the relative intensity of erosion as a function of relative time and this prediction is in fair agreement with experimental observations. Since the intensity of collision, the distance of shock transmission and the material failure are all statistical events, a generalization of the elementary theory is suggested. Some of the practical results of this theory are the predictions of the cumulative depth of erosion, the determination of erosion strength and the method of correlation with other parameters such as liquid properties and hydrodynamic factors. Modifications of this theory for brittle and viscoelastic materials are also suggested. Author (TAB)

N67-32800# RAND Corp., Santa Monica, Calif.
THE BLOWHARD PROBLEM—INVISCID FLOWS WITH SURFACE INJECTION
J. D. Cole and J. Aroesty Apr. 1967 50 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(RM-5196-ARPA; AD-653146) CFSTI: HC $3.00/MF $0.65

A simple model is presented for the analysis of inviscid flow fields over slender bodies accompanied by high rates of surface mass transfer. This model assumes a thin, inviscid injectant layer, which is separated from the outer flow by a contact discontinuity. Inviscid boundary-layer equations are shown to be applicable within the injectant layer, and the pressure gradient is found by matching pressure and flow direction at the dividing streamline. Using stream-function variables, an Abel integral equation is derived, and the inverse problem of determining the injection distribution from the shape of the dividing streamline is solved analytically for supersonic and hypersonic flow over flat plates and cones. Author (TAB)

N67-32843# Deutsche Versuchsanstal fur Luft- und Raumfahrt, Porz (West Germany). Institut fur Angewandte Gasdynamik.
ON THE BREAK-UP OF A LIQUID JET IN A REGULAR SEQUENCE OF UNIFORM-SIZED LIQUID DROPLETS
H. Wiegand May 1967 44 p refs
(DLR-FB-67-31)

Conditions of production and stability are described which will result in sequences of uniformly spaced liquid droplets having uniform size and moving at identical speed. Water, gas-oil, and glycerine were examined for conditions affecting production and limits of stability of such droplets. With regard to surface tension and viscosity, these three materials are representative of a wide range of liquids which are of technological interest for dispersion. K.W.

N67-32862# Kraichnan (Robert H.), Peterborough, N. H.
INERTIAL RANGES IN TWO-DIMENSIONAL TURBULENCE
Robert H. Kraichnan Jan. 1967 23 p refs
(Contract Nonr-4307(00))
(RR-11; AD-653111) CFSTI: HC $3.00/MF $0.65

Two-dimensional turbulence has both kinetic energy and mean-square vorticity as inviscid constants of motion. Consequently it admits two formal inertial ranges, E(k) is approx. (epsilon to the 2/3 power) k to the -5/3 power and E(k) is approx. (eta to the 2/3 power) k to the -3rd power, where epsilon is the rate of cascade of kinetic energy per unit mass, eta is the rate of cascade of mean-square vorticity, and the kinetic energy per unit mass is the integral from 0 to infinity E(k)dk. The -5/3 range is found to entail backward energy cascade, from higher to lower wavenumbers k, together with zero vorticity flow. The -3 range gives an upward vorticity flow and zero energy flow. The paradox in these results is resolved by the irreducibly triangular nature of the elementary wavenumber-interactions. The formal -3 range gives a nonlocal cascade and consequently must be modified by logarithmic factors. If energy is fed in at a constant rate to a band of wavenumbers approx. k sub i and the Reynolds number is large, it is conjectured that a quasisteady state results with a -5/3 range for k << k sub i and a -3 range for k >> k sub i, up to the viscous cut-off. The total kinetic energy increases steadily with time as the -5/3 range pushes to ever-lower k, until scales the size of the entire fluid are strongly excited. The rate of energy dissipation by viscosity decreases to zero if kinematic viscosity is decreased to zero with other parameters unchanged. Author (TAB)

N67-32885# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A KINETIC THEORY FOR SOURCE FLOW EXPANSIONS WITH APPLICATION TO THE FREE JET
Bernard B. Hamel and D. Roger Willis *In its* Hypersonic Rarefied Plasma Flows 15 Oct. 1966 38 p refs (See N67-32883 19-25)

A self-consistent hypersonic approximation was applied to the moment equations for source flow expansions. This approximation is well suited to the expansion problem since as the flow becomes rarefied it also becomes progressively more hypersonic. For the spherical expansion this allows us to resolve the problem to that of a relaxation process with two translational temperatures. In the

limit of small source Knudsen number, inner and outer expansions of the moment equations proceed and we obtain approximate analytic and numerical solutions. Expressions are also obtained for the terminal Mach numbers in terms of source Knudsen number and intermolecular force law, and a simple rarefaction criteria is proposed. Author

N67-32896# New York Univ., N. Y.
FINITE DIFFERENCE SOLUTION OF THE LAMINAR COMPRESSIBLE BOUNDARY LAYER EQUATIONS IN THE VON MISES VARIABLES WITH APPLICATIONS
Gdalia Kleinstein Wright-Patterson AFB, Ohio, ARL Mar. 1967 98 p refs
(Contract AF 33(615)-2215)
(NYU-AA-66-56; ARL-67-0050; AD-653208) CFSTI: HC $3.00/MF $0.65

A finite difference solution of the laminar compressible boundary layer equations in the von Mises variables is presented with applications to slot injection. The explicit scheme employed in the numerical method in conjunction with a set of compatibility conditions at the wall provides an accurate and efficient method of solution for the compressible boundary layer. From investigations of the decay of a disturbance in an incompressible zero pressure gradient flow a characteristic length is obtained beyond which local similarity may be taken as fully established independently of the initial velocity profiles. An analysis of the slot injection problem indicates that the pertinent parameters for slot cooling are the mass flow and stagnation temperature of the coolant. The effect of initial profiles must be included in those cases where transition is feasible. Author (TAB)

N67-32907# Sandia Corp., Livermore, Calif.
EQUILIBRIUM COMPOSITION AND SHOCK-WAVE CHARACTERISTICS OF FREON C-318
A. F. Emery Mar. 1967 70 p refs
(Contract AT(29-1)-789)
(SCL-RR-66-97) CFSTI: HC $3.00/MF $0.65

A discussion of the theoretical behavior of Freon C-318 in an aerodynamic shock tube with a stationary test model is based on an equilibrium composition determined by numerical calculations. Pressure calculations indicate that the ideal gas-flow properties would be very little affected by the decomposition of the gas which occurs behind the shock wave. Author (NSA)

N67-32923# Illinois Univ., Urbana. Coordinated Science Lab.
NUMERICAL STUDIES OF STRONG SHOCK WAVES. PART VIII: PROPERTIES OF A SHOCK WAVE FOR A MACH NUMBER OF 2.5
B. L. Hicks and M. A. Smith Apr. 1967 40 p refs
(Contract DA-28-043-AMC-00073(E))
(R-347-PT-8; AD-652591) CFSTI: HC $3.00/MF $0.65

The report describes a study of the structure of a shock wave in a gas of hard spheres for a Mach number M1 = 2.5. The characteristics of the velocity distribution function f, of the collision integral, and of moments of these functions are discussed in detail for nine stations within the shock wave. The structure was calculated by solving the (non-linear) Boltzmann difference equation by an iterative numerical method that includes Monte Carlo evaluation of the collision integral and a number of other new techniques. The 12th iterate is taken to be the solution of the difference equation. The average convergence error of this iterate is estimated to be not more than 0.5% of f. It is found that although departures of the calculated solution from the Mott-Smith shock are generally small they are the smallest on the upstream side of the shock. The most important specific results are the following: The largest deviation of the calculated velocity distribution functions from the Mott-Smith functions occurs near the hot side of the shock and near the cold peak in velocity space and amounts to 21% of f. The rms deviations at any given station in the shock are from four to ten times larger than the likely error at that station and eleven times larger than the estimated convergence error of the iteration method. Author (TAB)

N67-32924# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
FORCES ON A SPHERE MOVING STEADILY ALONG A CIRCULAR PATH IN A VISCOUS FLUID
Fust Odar Apr. 1967 13 p refs
(CRREL-RR-229; AD-652267) CFSTI: HC $3.00/MF $0.65

Forces on a sphere moving steadily along a circular path in viscous fluid are measured and it is found that within the experimental range both the longitudinal and normal forces are dependent on the Reynolds number and not on the radius of the path. Thus, the conventional drag coefficient can also be obtained from a rotational motion. Author (TAB)

N67-32935# Kraichnan (Robert H.), Peterborough, N. H.
LAGRANGIAN-HISTORY STATISTICAL THEORY FOR BURGERS EQUATION
Robert H. Kraichnan Jun. 1967 39 p refs
(Contract Nonr-4307(00))
(RR-12; AD-653112) CFSTI: HC $3.00/MF $0.65

The Lagrangian-history direct-interaction approximation for Burgers equation yields a 1/(k sq) inertial-range spectrum and an infinite-Reynolds-number similarity solution which describes stationary, decaying sawtooth shock waves. This solution differs only by a numerical factor from an exact statistical solution of Burgers equation into which almost all spatially periodic, zero-mean, infinite-Reynolds-number initial ensembles are expected to evolve. The different inertial-range predictions of the approximation for Burgers equation and Navier-Stokes dynamics (where k to the -5/3 power results) are directly associated with the effects of pressure-induced accelerations on Langrangian correlation times. Author (TAB)

N67-32963# Mississippi State Univ., State College. Dept. of Aerophysics.
AN EVALUATION OF THE SMOKE-WIRE TECHNIQUE FOR MEASURING VELOCITIES IN AIR
Curren J. Sanders and Joe F. Thompson, Jr. Mar. 1967 54 p refs *Its* Aerophysics Res. Rept. No. 70
(Contract DA-44-177-AMC-892(T))
(USAAVLABS-TR-67-29; AD-652275) CFSTI: HC $3.00/MF $0.65

In the smoke-wire technique, oil is evaporated from a very thin, high-resistance wire by the passage of a large electric current through the wire from a capacitor. The resulting line of smoke is carried downstream with the local velocity of the air, deforming so that a photograph of the smoke line after a measured time delay provides a velocity profile. Since the time delay is very short, this velocity profile is very close to the actual velocity profile at the location of the wire. The technique was evaluated in two- and three-dimensional air flows, both laminar and turbulent, by comparisons with theoretical profiles. Experimental velocity profiles compared quite favorably with theoretical solutions for several different types of flows, including boundary layers, jets, wakes, and vortices. Modifications of the technique and associated apparatus were made in order to extend its scope of application. Author (TAB)

N67-33028 Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaire.
CONTRIBUTION TO THE STUDY OF THE ELECTROSTATIC PRECIPITATION OF AEROSOLS [CONTRIBUTION A L'ETUDE DE LA PRECIPATION ELECTROSTATIQUE DES AEROSOLS]
Lucien Roure (Soc. Bertin) and Guy Madeleine Sep. 1966 81 p refs In FRENCH; ENGLISH summary
(CEA-R-3069)

The first part is devoted to the theory of the electrostatic precipitation of ions in a cylindrical apparatus. Some aerodynamic factors influencing the quality of the flow are deduced. The second part of the report deals with the experimental verification of the hypotheses concerning the laminarity of the gas flow. The presence of a guard tube which ensures a steady state of velocity and which reduces electrical field end-effects should make it possible to obtain a better knowledge of the distribution function of the captured particles. The third part deals with the treatment of the results and with the processing method making it possible to obtain the spectral distribution of the particles captured on the electrode. Author

N67-33109# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics.

ON THE GROWTH AND DECAY OF DISCONTINUITIES IN FLUIDS WITH INTERNAL STATE VARIABLES

Bernard D. Coleman and Morton E. Gurtin Feb. 1967 26 p refs

(Contract Nonr-51031)

(TR-67-14; AD-652587) CFSTI: HC $3.00/MF $0.65

In the non-linear theory of one-dimensional motions of fluids exhibiting mechanical dissipation through the relaxation of internal state variables, one can derive exact expressions for the growth and attenuation of acceleration waves and higher-order waves. The methods and concepts used are simpler than those required for analogous problems in the general theory of materials with fading memory. Here we discuss in detail the time dependence of the amplitude of waves propagating into homogeneous regions at equilibrium. Author (TAB)

N67-33152# Illinois Univ., Urbana. Coordinated Science Lab.

NUMERICAL STUDIES OF STRONG SHOCK WAVES. PART IX: ERROR ANALYSIS FOR MACH NUMBER OF 2.5

B. L. Hicks and M. A. Smith Apr. 1967 27 p refs

(Contracts DA-28-043-AMC-00073(E); N00014-66-C-0010-A01)

(R-348; AD-652592) CFSTI: HC $3.00/MF $0.65

Data from 43 computer runs makes possible a study of the Monte Carlo, iterative solutions of the Boltzmann difference equations for a strong shock wave (M1 = 2.5). Estimates have been made of errors associated with iterative convergence, Monte Carlo sampling, number of stations in the shock and variations of the zero-th iterate. Specific results are summarized at the end of the report. Author (TAB)

N67-33209# California Univ., Livermore. Lawrence Radiation Lab.

HYDRODYNAMICS

J. Viecelli *In its* Phys. Dept. Rept., Jun.–Sep. 1966 p 48–50 refs (See N67-33206 19-23)

In a hydrodynamic research project, a further diffusion approximation to the net transport for an equilibrium of uniformly distributed energy is tested. An energy equation is derived in which the turbulent energy transport is approximated. The diffusion approximation leads to a relatively simple numerical model of turbulence and is probably not much less accurate than the other approximations considered. In an evaluation of safety shielding from blast waves, an analytic approach is used, based on the linearization of the conservative equations to a wave equation. The theory of wave reflection from a layered half-space is then used to derive a series solution containing Airy integral coefficients. The series is evaluated on the computer and the results are compared with pressure records of explosion wave returns from the ozonosphere. R.U.

N67-33237# Naval Academy, Annapolis, Md. Dept. of Engineering.

AXISYMMETRIC VISCOUS INTERACTION WITH SMALL VELOCITY SLIP AND TRANSVERSE CURVATURE EFFECTS

David F. Rogers Jun. 1967 216 p refs

(E-67-2; AD-653467) CFSTI: HC $3.00/MF $0.65

The flow about an unyawed cone is considered for the hypersonic moderately low density regime. The shock wave boundary layer interaction is considered in the context of the hypersonic strong interaction approximation. Small transverse curvature and small surface slip effects are considered as perturbations on the basic strong interaction solution. Solutions of the governing two-point boundary value problems are obtained by reduction to a system of ordinary differential equations using double asymptotic expansions in a slip parameter and a hypersonic transverse curvature parameter which is proportional to M2 times the Probstein and Elliott transverse curvature parameter. This implies an additional restriction on the transverse curvature solutions in the hypersonic flow regime. The effect of the self-induced pressure gradient is to increase the skin friction and heat transfer rate at the wall. The first-order slip effect increases the boundary layer mass flow and heat transfer rate. Skin friction surface pressure and displacement thickness are increased for wall-to-stagnation temperature ratios <0.30 and decreased for wall-to-stagnation temperature ratios >0.30. The first-order transverse curvature effect decreases the boundary layer mass flow rate, surface pressure, and displacement thickness, whereas the skin friction and wall heat transfer rate are increased. Author (TAB)

N67-33261# Bureau of Mines, Morgantown, W. Va. Petroleum Research Lab.

EFFECTS OF ULTRASONIC ENERGY ON FLUID FLOW IN POROUS MEDIA

Charles A. Komar and Clyde Pierce Jul. 1967 18 p refs

(BM-RI-6978)

Experiments on one synthetic and three natural sandstone samples to investigate the effects of acoustic energy on the flow of brine in porous media were conducted. Ultrasonic energy at a frequency of 20 kc per second and an intensity of 55 watts per cm^2 was irradiated in the direction of the fluid flow and in the opposite direction for distances of 1/2 and 2 inches between the vibrating device and the sample face and under conditions of suppressed and nonsuppressed cavitation. Forty tests were conducted: 32 with a pressure differential of 0.64 psi across the samples, 2 with 5 psi, and 6 with 15 psi. Acoustic waves altered the rate of flow of the brine through the samples, but this effect was observed only at low differential pressures and from a practical point of view was insignificant. As a result of irradiation, however, the samples exhibited reduced permeability. This reduction was probably caused by the shifting of solid particles dislodged by the acoustic waves. Author

N67-33276# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.

ON WAKES IN STRATIFIED FLUIDS

Gerald S. Janowitz Apr. 1967 111 p refs

(Contract Nonr-4010(01); Grant ESSA-E-9-67)

(TR-22; TR-25; AD-651570) CFSTI: HC $3.00/MF $0.65

The paper considers two-dimensional flow induced by a body moving with constant speed through a linearly stratified fluid. The solution shows a diffusive wake far upstream of the body. Less far upstream, a system of jets occurs; these jets become stronger and more narrow as the body is approached. An increase in speed or diffusivity weakens these jets. We find at low speeds, low diffusivities, and moderate distances upstream of the body, that the velocity along the x-axis given by the exact solution is well approximated by the upstream asymptotic nondiffusive solution. Far downstream of the body, the solution shows a diffusive wake identical with the far upstream diffusive wake. In the downstream region nearer the body, at high speeds, a wake exists which is similar to the homogeneous wake. At low speeds in this downstream

region near the body, the solution shows a pattern of waves decaying in the downstream direction. TAB

N67-33299# Naval Research Lab., Washington, D. C.
DRAG REDUCTION BY DILUTE POLYMER SOLUTIONS IN TURBULENT FLOW
Ralph C. Little 31 May 1967 25 p refs
(NRL-6542; AD-654160) CFSTI: HC $3.00/MF $0.65

The mechanism by which water-soluble polymers reduce hydrodynamic drag on solid surfaces was investigated by measurements of flow birefringence and of turbulent flow in pipes. Flow birefringence and flow field orientation of Polyox polymers in the molecular weight range from 200,000 to 6,000,000 showed that Polyox macromolecules continue to deform with increasing velocity gradient even after alignment with the flow field (at gradients in excess of 2000/sec). All solutions used were found to be Newtonian, with the exception of the AcrysolA-5 solutions. The flow data for Polyox solutions in a Pyrex pipe were examined in terms of Meyers fluid property parameter and Elatas relaxation time hypothesis for the initiation of drag reduction. It was found that drag reduction in the Pyrex pipe was initiated at a value of the order of one-fifth that predicted by Elatas theory. Moreover, added salt (the solution being 0.3 molar in K2SO4) had no effect on the flow of Polyox Coagulant solutions even though the intrinsic viscosity (upon which Rouse relaxation times depend) was cut to slightly more than one-third of its value in the pure solvent. The unusually high values of Meyers fluid property parameter observed at low concentrations suggests that adsorption on the Pyrex pipe walls may be playing a role in drag reduction. Author (TAB)

N67-33336# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
EXPERIMENTAL ANALYSIS OF THE NEAR-WAKE OF A SLENDER BODY WITH NO LATERAL SUPPORT [ANALYSE EXPERIMENTALE DU PROCHE SILLAGE D'UN CORPS ELANCE LIBRE DE TOUT SUPPORT LATERAL]
Maurice Sirieix and Jean Delery 1967 47 p refs In FRENCH
Presented at the A.G.A.R.D. Meeting on Plasmas Occurring in Wakes, Fort Collins, Colo., 10–12 May 1967
(ONERA-TP-454(1967)) CFSTI: HC $3.00/MF $0.65

Testing conditions without any parasite interaction for studying experimentally the near-wake of axisymmetric bodies were studied. Hence, either streamlined supports fixed upstream of the throat of Mach 1.92 and Mach 4 nozzles designed to study cylindrical afterbodies in turbulent flow were used or a magnetic suspension for the blunt and slender model (HB1) which was tested at Mach 5 in laminar flow. The results obtained include a detailed analysis of the flow at the base and are compared with some existing theoretical elements. At the same time, a hot-wire transition investigation, in the case of wake of a cylinder normal to the flow, was carried out at Mach 2.3 and provided an experimental criterion for transition. Author (ESRO)

N67-33437# Naval Ordnance Lab., White Oak, Md.
CAVITY SHAPES AT VERTICAL WATER ENTRY—A COMPARISON OF CALCULATED AND OBSERVED SHAPES
Harvey I. Abelson 29 Jun. 1967 27 p refs *Its* Ballistics Res. Rept.-171 First Revision
(NOLTR-67-31; AD-653717) CFSTI: HC $3.00/MF $0.65

For vertical water entries which result in the formation of open cavities, the cavity shapes as predicted by Birkhoffs hydraulic flow model are shown to correspond very well to observed cavity shapes for spheres of different sizes and materials. Author (TAB)

N67-33442*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SUBCOOLING AND RADIATION ON FILM-BOILING HEAT TRANSFER FROM A FLAT PLATE
Thomas D. Hamill and Kenneth I. Baumeister Washington, NASA, Aug. 1967 41 p refs
(NASA-TN-D-3925) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A maximum entropy rate postulate is used in the theoretical analysis of the problem of film boiling from a horizontal plate with both subcooling and radiation present. To compute the overall heat transfer coefficient, equations are derived from combining three coefficients: the saturated film boiling coefficient, the radiation coefficient, and the liquid free-convection coefficient. The three temperatures that characterize the subcooling parameter are identified as the wall temperature, saturation temperature, and bulk temperature of the liquid. A general method of solution is formulated. Tabulated numerical results are also presented to show the effect of subcooling and radiation on dome spacing and overall heat transfer coefficient. M.G.J.

N67-33540# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THEORETICAL AND EXPERIMENTAL STUDIES OF LAMINAR FLOW SEPARATION ON FLAT PLATE-WEDGE COMPRESSION SURFACES IN THE HYPERSONIC STRONG INTERACTION REGIME Final Report, Dec. 1963–Dec. 1966
M. S. Holden May 1967 88 p refs
(Contract AF 33(615)-1205)
(CAL-AF-1894-A-2; ARL-67-0112; AD-653985) CFSTI: HC $3.00/MF $0.65

The report describes a theoretical and experimental investigation of the properties of attached and separated regions of shock wave-laminar boundary layer interactions in the strong interaction regime. A study was made of the flow over a flat plate-wedge compression surface in the high Mach number, low Reynolds number regime where the interaction between the viscous and inviscid regions over the basic flat plate is strong and of fundamental importance to the problem. The theoretical analysis described in the first part of the paper treats the development of the viscous layer and its interaction with the external inviscid stream, using an integral representation for the boundary layer equations. The analysis describes the strong interaction over the flat plate, the transition from a supercritical to a subcritical boundary layer upstream of the separation point, and the subsequent development of the viscous layer through to the end of the interaction. The theory was compared with experimental measurements in both strong and weak interaction regions of separated flow. The complementary experimental study described in the second part of the paper was designed to investigate the shock wave-boundary layer interaction on flat plate-wedge compression surfaces in the strong interaction regime. Author (TAB)

N67-33556 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR NEWS OF THE MECHANICS AND MACHINE BUILDING
17 Mar. 1967 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1964 p 48–52 138–140
(FTD-MT-65-325; AD-652466) CFSTI: HC $3.00/MF $0.65

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1. VISCOUS HYPERSONIC FLOW AFTER A PARABOLIC AXIALLY SYMMETRIC SHOCK V. S. Nikolayev p 1–7 refs (See N67-33557 19-12)

2. ON THE FORM OF A BOW SHOCK WAVE DURING HYPERSONIC FLOW AROUND BLUNT BODIES V. V. Lunev p 9–12 refs (See N67-33558 19-12)

N67-33557 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VISCOUS HYPERSONIC FLOW AFTER A PARABOLIC AXIALLY SYMMETRIC SHOCK

V. S. Nikolayev *In its* News of the Acad. of Sci. of the USSR Mech. and Machine Bldg. 17 Mar. 1967 p 1–7 refs (See N67-33556 19-12)

The inverse problem of determining a field of flow after a parabolic axially symmetric jump is considered, taking into account the interaction of a boundary layer with an inviscid flow. For the description of an inviscid flow, the theory of small perturbations is used. On the basis of an analysis of orders of magnitude there is considered the question of joining the parameters of the inviscid flow. There is given a formulation of the problem which allows the consideration of interaction connected with the expelling influence of the boundary layer as well as the vortex interaction. Results of numerical calculations of the field of flow between the body and the compression shock are given. Author

N67-33556 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE FORM OF A BOW SHOCK WAVE DURING HYPERSONIC FLOW AROUND BLUNT BODIES

V. V. Lunev *In its* News of the Acad. of Sci. of the USSR Mech. and Machine Bldg. 17 Mar. 1967 p 9–12 refs (See N67-33556 19-12)

This article describes the hypersonic flow around axially symmetric slender bodies by a viscous or inviscid gas. The flow of the body adjoins the surface high-entropy layer, and shock waves formed near the blunt nose have to be identical in similarity coordinates. Equations and parabolic curves are given. The considerations and conclusions extend to the case around the bodies by gas with imbalanced physico–chemical transformations only with the difference that the shock wave form will still depend on the given parameters. Author

N67-33576# IIT Research Inst., Chicago, Ill.

RESEARCH ON MIXING OF COAXIAL STREAMS

A. A. Fejer, T. P. Torda, L. I. Boehman, K. N. Ghia, and W. G. Hermann Wright-Patterson AFB, Ohio, ARL, Mar. 1967 p 192 refs

(Contract AF 33(615)-1024)

(ARL-67-0058; AD-654014) CFSTI: HC $3.00/MF $0.65

The report presents the results of experimental and analytical investigations of the confined coaxial mixing of isoenergetic air streams. Both uniflowing and counterflowing secondary air streams are considered. Laminar and turbulent uniflow mixing are treated analytically. The results of experimental investigations of turbulent mixing are used to calculate the radial as well as the axial variations of eddy viscosity and the turbulent diffusion coefficient up to 25 jet diameters downstream of jet orifice. New expressions are developed to yield reliable values in regions of mixing where existing expressions become indeterminate. Special consideration is given to the case where the two streams have equal velocity. The experimental investigation of turbulent counterflow mixing shows that a toroidal shaped vortex is set up at the jet interface which gives rise to depressed static pressures. Over the range of parameters investigated, entrainment of fluid from the inner jet into the external stream takes place downstream of the vortex. Author (TAB)

N67-33581 Lockheed Missiles and Space Co., Palo Alto, Calif.

RELAXATION AND RADIATION BEHIND A NORMAL COMPRESSION SHOCK

A. K. Artamonov, V. N. Arkhipov, and G. E. Starchenko 1967 6 p refs Transl. into ENGLISH from Mekh. Zhidk i Gaza, no. 3, 1966 p 20–23

Consideration is given to a problem concerned with an equilibrium supersonic air flow consisting of 75.52% (by weight) molecular nitrogen, 23.14% molecular oxygen, and 1.34% argon incident on a fixed normal shock. The progressive and rotational energies everywhere behind the shock are assumed to have their equilibrium values, and the vibrational and electron excitation processes as well as dissociation and ionization are considered to proceed in a nonequilibrium fashion. The ionization is assumed to be single and the free electron temperature to equal everywhere the progressive temperature of the heavy particles. The radiation associated with transitions between different states is accounted for, and the influence of viscosity, diffusion, and heat conduction, as well as the contribution of the radiation to the pressure and density is neglected. C.T.C.

N67-33585* Oklahoma State Univ., Stillwater. Fluid Power and Controls Lab.

STUDY OF FLUID TRANSIENTS IN CLOSED CONDUITS

Hudy C. Hewitt 1967 136 p refs

(Contract NAS8-11302)

(NASA-CR-88290; IR-66-7) CSCL 20D

Results are presented of an investigation to extend the knowledge of bubble dynamics into the field of cryogens. Photographic records of vapor bubbles in superheated liquid nitrogen were obtained experimentally, and the dynamic behavior of these bubbles was measured and compared to the behavior predicted theoretically for non-cryogens. Experimental measurements of heat transfer controlled bubble collapse in liquid nitrogen were made, theoretical solutions of the bubble dynamics equations governing heat transfer controlled collapse are presented, and possible modifications of these solutions are suggested. The equations governing bubble growth with transient liquid pressure were developed, and the solution for the case where the change in bubble wall temperature can be neglected is presented. Three nitrogen vapor bubbles were measured for liquid pressure variation, and these measurements are compared to the theoretical solution for inertia controlled growth and to the theoretical solution for bubble growth in a superheated liquid. C.T.C.

N67-33651# David Taylor Model Basin, Washington, D. C.

IRROTATIONAL FLOW OF FRICTIONLESS FLUIDS, MOSTLY OF INVARIABLE DENSITY Final Report

Earle H. Kennard Feb. 1967 438 p refs

(DTMB-2299; AD-653463) CFSTI: HC $3.00/MF $0.65

The book treats the known types of the potential flow of frictionless fluids having a uniform and invariable density. The main topics are: fundamentals of the irrotational flow of frictionless fluids; the use of complex functions in hydrodynamics; cases of two-dimensional flow - specific subjects treated are simple flow, line singularities, transformations, forces on cylinders, airfoil theory, rotating boundaries, flow in channels and free streamlines; cases of three-dimensional flow; coefficients of inertia. Author (TAB)

N67-33662# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

SOME SPECTRAL FUNCTIONS COMPATIBLE WITH HEISENBERG'S THEORY IN AXISYMMETRIC TURBULENCE

Pierre Salaun 1967 16 p refs Presented at the Symp. on the Struct. of Turbulence, Southampton, Gt. Brit., 29–31 Mar. 1967

(ONERA-TP-461(1967)) CFSTI: HC $3.00/MF $0.65

It is already known that in homogeneous, axisymmetric turbulence, and in an incompressible fluid, both correlation tensor and spectrum tensor can be written with the help of two scalar functions only; this is shown here in a new manner. As long as Heisenberg's theory is valid in the equilibrium range, one can write a relation between the two scalar spectrum functions. It is the purpose of this paper to propose some expressions of these functions compatible with theory. Some lateral correlations and spectra useful in aircraft engineering are then examined. Author (ESRO)

N67-33692# Stanford Univ., Calif. Dept. of Mathematics.

SCATTERING OF SURFACE WAVES BY SUBMERGED CIRCULAR CYLINDERS. PART II: SCATTERING BY AN INFINITE ARRAY OF CYLINDERS

Jon T. Schnute 14 Jun. 1967 61 p refs
(Contract Nonr-225(74))
(TR-11; AD-653752) CFSTI: HC $3.00/MF $0.65

The paper deals with progressive surface wave motions of a small amplitude and time-periodic nature in an ideal fluid which contains an infinite submerged array of parallel and identical circular cylinders. Their characterization is sought in the framework of a homogeneous linear boundary value problem for harmonic functions which exhibit a common phase shift (that plays the role of an eigenvalue) for any displacement along the direction of wave propagation with a magnitude equal to the separation between adjacent cylinders. An equivalent integral equation is formulated and reduced to an infinite homogeneous linear system from which there obtains a determinantal condition that specifies the dependence of the eigenvalue, or effective wave number, on the frequency, gravitation constant, and geometric parameters. Approximations to the eigenvalue are calculated for any fixed wave length when (1) the radius of the cylinders is small compared with their spacing or (2) their separation distance is large with respect to the radius and depth of immersion. Author (TAB)

N67-33770# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LENINGRAD. POLYTECHNIC INSTITUTE. TRANSACTIONS Selected Articles
5 Dec. 1966 49 p refs Transl. into ENGLISH from Tekhn. Gidrogazodinam. (Leningrad), no. 248, 1965
(FTD-TT-65-1713; TT-67-61600; AD-650807) CFSTI: HC $3.00/MF $0.65

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1. PARAMETRIC METHOD OF INTEGRATING THE EQUATIONS OF A LAMINAR BOUNDARY LAYER L. G. Loytsyanski p 1–15 refs (See N67-33771 19-12)

2. NUMERICAL SOLUTION OF EQUATIONS IN THE ONE-PARAMETER THEORY OF BOUNDARY LAYERS L. M. Simuni and N. M. Terent'yev p 16–20 refs (See N67-33772 19-12)

3. AXIALLY SYMMETRIC LAMINAR BOUNDARY LAYER IN A SWIRLING FLOW V. V. Bogdanova p 21–32 refs (See N67-33773 19-12)

4. EFFECT OF CATALYTIC RECOMBINATION ON HEAT TRANSFER IN A "FROZEN" TURBULENT BOUNDARY LAYER U. V. Lapin p 33–41 refs (See N67-33774 19-33)

N67-33771# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PARAMETRIC METHOD OF INTEGRATING THE EQUATIONS OF A LAMINAR BOUNDARY LAYER
L. G. Loytsyanski *In its* Leningrad. Polytech. Inst. Trans. 5 Dec. 1966 p 1–15 refs (See N67-33770 19-12)

The method of integration described falls between the numeric and analytical methods. The longitudinal coordinate is eliminated, and a system of successive form parameters, comprising the effect of velocity distribution on the exterior limit of the boundary layer, is substituted. Tables and diagrams of the boundary layer characteristics are included. Representation of the solution in the form of a power series expansion is discussed, and an example of calculation is given. It is pointed out that studies indicate the method can be generalized and applied to more complex cases of boundary layer in high velocity gas flows. N.E.N.

N67-33772# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUMERICAL SOLUTION OF EQUATIONS IN THE ONE-PARAMETER THEORY OF BOUNDARY LAYERS
L. M. Simuni and N. M. Terent'yev *In its* Leningrad. Polytech. Inst. Trans. 5 Dec. 1966 p 16–20 refs (See N67-33770 19-12)

A computer method of solving the boundary layer equation is outlined. The one-parameter differential equation is reduced to a linear system. A check was performed, and it is considered that the method gives sufficient accuracy. N.E.N.

N67-33773# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AXIALLY SYMMETRIC LAMINAR BOUNDARY LAYER IN A SWIRLING FLOW
V. V. Bogdanova *In its* Leningrad. Polytech. Inst. Trans. 5 Dec. 1966 p 21–32 refs (See N67-33770 19-12)

Self-modeling solutions are presented for equations of the laminar flow of a viscous incompressible fluid in the boundary layer at the walls of an axisymmetric duct with a curvilinear generatrix. The relation between pressure and velocity of external flow is determined, and the method of plotting the self-modeling solutions is described. Results showing the functions for different values of parameters and the variations of the parameters are graphed. The conditions under which breakaway occurs is also established. N.E.N.

N67-33874# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING THE PROBLEM OF THE FLOW OF A HYPERSONIC STREAM OF GAS AROUND A THIN BODY
N. M. Monakhov 23 Jan. 1967 7 p refs Transl. into ENGLISH from Tr. Kazansk. Aviats. Inst. (Kazan), no. 71, 1962 p 50–55
(FTD-HT-66-411; TT-67-62108; AD-653547) CFSTI: HC $3.00/MF $0.65

The hypersonic flow of an ideal gas over slender bodies is discussed. The flow Mach number is assumed to be infinite and is directed along the x-axis. Nondimensional coordinates are introduced, and a boundary value problem is obtained in nondimensional form. TAB

N67-33956# California Univ., Berkeley. Lawrence Radiation Lab.
NECESSARY CONDITIONS FOR SIMILAR SOLUTIONS OF PROBLEMS OF TURBULENT-GAS DYNAMICS
Barbara K. Crowley 31 Jan. 1967 29 p refs
(Contract W-7405-ENG-48)
(UCRL-50211) CFSTI: HC $3.00/MF $0.65

The quasi-one-dimensional conservation equations with friction, heat, and mass sources are considered. Necessary conditions for similar solutions of these equations are mathematically derived, and these conditions are verified by sample computer calculations. Author (NSA)

N67-33972*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PARAMETRIC ANALYSIS OF ELECTROSTATIC DISPERSION OF A LIQUID
Allan Sherman Jul. 1967 22 p refs
(NASA-TM-X-55850; X-734-67-321) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A theoretical model for the electrostatic dispersion of a fluid is presented. The analysis results in equations for charge-to-mass ratio, velocity, and droplet radius as a function of flow-voltage parameters. Data from colloid rocket tests agree favorably with theory. The results are useful for colloid-rocket data correlation. Author

N67-33990# Bureau of Mines, Amarillo, Tex. Helium Research Center.
STEADY-STATE LAMINAR FLOW BOUNDARY CONDITIONS FOR A STAINLESS STEEL COILED-CAPILLARY VISCOSIMETER
Ross A. Guereca, H. P. Richardson, and L. M. Walker Aug. 1967 19 p refs
(BM-RI-6995)

An analysis to determine criteria for steady-state, laminar flow boundary conditions for a coiled-tube gas viscosimeter by comparing experimental data from a thick-walled, stainless steel capillary in a horizontal, straight-tube condition, with similar data taken after the same capillary was formed into a helix is presented. Overlapping volumetric flowrates and pressure drops are covered for both configurations at pressure levels of 28, 225, and 1,000 psia at 300°K. Friction factor, Reynolds number, and Dean number correlation plots show conditions where the coiled-tube flow deviates from straight-tube flow. The coiled-tube data indicate departure from Poiseuille steady-state laminar flow at a Reynolds number close to 390 and a Dean number of about 15. Below these conditions and consistent with the data reported, Dean's circulation appears negligible. For the particular coil used, a conservative upper limit of 10 is chosen for the Dean number corresponding to an upper limit of about 250 for the Reynolds number. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N67-32701# Philco Corp., Blue Bell, Pa. Communications and Electronics Div.

STUDY OF LASA DATA LINKS Technical Report, 1 Jul.–1 Nov. 1966

Don R. Fink and Robert S. Dahlberg Mar. 1967 64 p

(Contract AF 19(628)-6141; ARPA Order 600)

(ESD-TR-67-221; AD-653223) CFSTI: HC $3.00/MF $0.65

Investigation has been directed toward the utilization of data links for dissemination of seismic information from the Montana Large Aperture Seismic Array (LASA) to the scientific community. Methods and equipments are readily available for providing an essentially on-line seismic data link between Montana LASA and potential data users. Analog and/or digital data transmission appears feasible, and relative requirements and costs per data channel have been detailed. As a result of the study, which included a survey of the seismological community, it is recommended that a teletype station bulletin be made available to those desiring it. It is also recommended that consideration be given to providing a data transmission facility at the Montana LASA Data Center so that data can be transmitted directly to interested users. In addition, recommendation is made to investigate possible alternative approaches for mass storage of seismic data. Author (TAB)

N67-32704# Illinois Univ., Urbana. Electrical Engineering Research Lab.

IONOSPHERE RESEARCH Quarterly Progress Report, 1 Oct.–31 Dec. 1966

H. D. Webb Jan. 1967 93 p refs

(Contract DA-36-039-AMC-03703(E))

(QPR-13; AD-653160) CFSTI: HC $3.00/MF $0.65

Moon reflected signals were received at 150.6 mc on 30 days for 204 hours of operation and at 413.25 mc on 29 days for 56 hours of operation. Most of the days were magnetically quiet. There were importance 2 flares on some of the days. The receiving station may be operated automatically on 150.6 mc. A thesis for the M.S. degree which gives details of the automatic operation is appended. The ratio of the topside to bottomside ionospheric electron content is being calculated for October 1965 using Ft. Monmouth ionograms and lunar reflection data. Volume IV of the Atlas of Lunar Data, for observation days from January 1 through December 31, 1965 has been distributed. Signals from the stationary satellite ATS-1 have been successfully received and recorded on two frequencies near 136 mc. Author (TAB)

N67-32705# General Electric Co., Philadelphia, Pa. Missile and Space Div.

REFLECTION AND POLARIZATION PROPERTIES OF POWDER MATERIALS

H. H. Blau, Jr., E. L. Gray, and G. M. B. Bouricius Jun. 1967 30 p refs

(R67SD29; AD-653197) CFSTI: HC $3.00/MF $0.65

Directional radiance factors and polarization are presented for pure silicon carbide powder with an average albedo of .15 over a size range from 8 to 86 microns, pure aluminum oxide powder with average albedo about .85 over a size range from 0.1 to 86 microns, and for a mixture of one part silicon carbide to six parts aluminum oxide with average albedo of about .40 over a size range from 5 to 86 microns. Author (TAB)

N67-32761# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

AN ALGORITHM FOR OBTAINING SOLUTIONS TO LAPLACE'S TIDAL EQUATIONS

J. Q. Longyear Mar. 1967 32 p refs

(ECOM-5113; AD-653002) CFSTI: HC $3.00/MF $0.65

An algorithm, suitable for use on most computers, for obtaining solutions to Laplaces tidal equations for tides of longitudinal wave number one and of arbitrary period is described. Relevant proofs are included and a comparison is made between the equivalent depths found by this method and by those of Kato and Lindzen. A computer flow chart for the basic program is also given. TAB

N67-32786# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

THE D-REGION FAIR-WEATHER ELECTRIC FIELD

Willis L. Webb and Max C. Bolen Apr. 1967 26 p refs

(ECOM-5120; AD-653006) CFSTI: HC $3.00/MF $0.65

Motion of a slightly ionized medium such as the earth's lower ionosphere through a magnetic field such as the earth's permanent magnetic field will result in systematic separation of electrical charges. This charge separation will result in development of an opposing electric field which will balance, in the average case, the force produced by the interaction of the motion and the magnetic field. The D-region fair-weather electric field is defined as the equilibrium field produced by the mean circulation. Asymmetries between the earth's geomagnetic and rotational axes and the structure of the stratospheric circulation are considered in determining global and annual structures of the D-region fair-weather electric field. Author (TAB)

N67-32808# Southwest Center for Advanced Studies, Dallas, Tex. Geosciences Div.

P AND S TRAVEL TIME ANOMALIES AND THEIR INTERPRETATION

A. L. Hales and H. A. Doyle 1 Apr. 1967 30 p refs *Its* Contr. 47

(Contract AF 19(628)-2936; ARPA Order-292; Proj. Vela-Uniform)

(AFCRL-67-0265; SR-4; AD-652219) CFSTI: HC $3.00/MF $0.65

Study of the deviations of P and S travel times from the J-B tables at teleseismic distances has shown that there are regional differences in travel time. Both P and S are early in the central and eastern United States, late in the western United States. The differences have a range of about three seconds for P and eight seconds for S. It can be deduced from the relation between the travel time residuals (1) that the change in shear velocity is

approximately one and one-quarter times the change in P velocity, (2) that the observations imply a difference in Poissons ratio between the two regions, and (3) that a model in which the shear modulus alone varies, the compressibility remaining sensibly constant, fits the data best. It can be shown also that the differences between the P travel time residuals and the gravity anomalies in the central and western United States are not consistent with the Birch relation between velocity and density. Author (TAB)

N67-32809# Southwest Center for Advanced Studies, Dallas, Tex. Geosciences Div.

AN ANALYSIS OF THE TRAVEL TIMES OF S WAVES TO NORTH AMERICAN STATIONS, IN THE DISTANCE RANGE 28° TO 82°

H. A. Doyle and A. L. Hales 1 Apr. 1967 29 p refs *Its* Contr. 42

(Contract AF 19(628)-2936; ARPA Order-292; Proj. Vela-Uniform) (AFCRL-67-0264; SR-3; AD-652220) CFSTI: HC $3.00/MF $0.65

The travel times of S waves from 20 earthquakes to stations in North America in the distance range 28 degrees to 82 degrees have been studied. The deviations from J-B times were analyzed into station, source and distance components using the least-squares time-term approach of Cleary and Hales. Station anomalies had a range of about eight seconds, as compared to three seconds for the P anomalies, and are believed to be caused largely by variations in the upper mantle velocity distribution. S residuals, like the P residuals, were generally positive in the western United States, and negative in the central and eastern United States. P and S residuals at the same station correlated with a coefficient of 0.75, the slope of the regression of S anomaly on P anomaly being 3.72. Corrections to J-B times for S were of the order of the standard errors of the determinations. Within the distance range of 28 degrees to 82 degrees large changes of the S velocities, such as were suggested by MacDonald and Ness (1961), are not permitted by the present data. The analysis was checked by carrying out a univariate analysis of variance of the same data. Author (TAB)

N67-32817# Academy of Sciences (USSR), Moscow.

IONOSPHERIC RESEARCHES (ARTICLES 14)

1965 190 p refs In RUSSIAN; ENGLISH summaries CFSTI: HC $3.00/MF $0.65

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2. CORPUSCULAR HYPOTHESIS ON NIGHT IONOSPHERIC IONIZATION L. A. Antonova and G. S. Ivanov-Kholodny p 9–12 refs (See N67-32819 19-13)

3. PECULIARITIES OF REGULAR VARIATIONS OF IONIZATION AND STRUCTURAL PARAMETERS OF IONOSPHERIC F2 REGION V. M. Polyakov and L. A. Schepkin p 13–20 refs (See N67-32820 19-13)

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9. ON RELATIONS BETWEEN IONOSPHERIC MOVEMENTS AND MAGNETIC ACTIVITY V. D. Kokourov p 77–85 refs (See N67-32826 19-13)

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11. IONOSPHERIC IRREGULAR PHENOMENA AND DISTURBANCES IN HIGH LATITUDES A. S. Besprozvannaya and G. N. Gorbushina p 94–99 refs (See N67-32828 19-13)

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13. SOME PECULIARITIES OF MAGNETO-IONOSPHERE DISTURBANCES IN THE FRONT ZONE Ye. P. Glushkova p 104–116 refs (See N67-32830 19-29)

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15. IONOSPHERIC PARAMETERS DEPENDENCE ON SOLAR WAVE MISSION ENTERING THE EARTH'S ATMOSPHERE A. I. Likhachov, Yu. N. Yelizaryov, G. V. Yegorova, and N. I. Timchenko p 129–140 refs (See N67-32832 19-29)

16. RELATIONS BETWEEN IONOSPHERIC AND ATMOSPHERIC DYNAMICS ACCORDING TO THE MATERIALS OF STATIONS IN THE URALS AND SIBERIA, NORTH CAUCASUS AND MIDDLE ASIA DURING THE IGY V. N. Kessenikh, E. S. Kazimirovsky, and U. A. Novikova p 141–145 refs (See N67-32833 19-13)

17. VISIBLE DISTRIBUTION OF SPORADIC METEOR RADIANTS ACCORDING TO AZIMUTH RADAR OBSERVATIONS Yu. A. Poupyshev p 146–162 refs (See N67-32834 19-13)

N67-32819# Academy of Sciences (USSR), Moscow.

CORPUSCULAR HYPOTHESIS ON NIGHT IONOSPHERIC IONIZATION

L. A. Antonova, G. S. Ivanov-Kholodny *In its* Ionospheric Res. 1965 p 9–12 refs (See N67-32817 19-13)

It is suggested that in the upper layers of the atmosphere higher than 300 km there is a stream of weak electrons which causes the formation of the ionosphere in the night-time when passing through the lower layers. Sporadic increase of the stream of electons causes sudden disturbances of the ionosphere and aurora. According to new data about the coefficient of the recombinations rate in the ionosphere and the data about n_e in the night ionosphere, the intensity and the spectrum of the stream of electrons are calculated. Author

N67-32820# Academy of Sciences (USSR), Moscow.

PECULIARITIES OF REGULAR VARIATIONS OF IONIZATION AND STRUCTURAL PARAMETERS OF IONOSPHERIC F2 REGION

V. M. Polyakov and L. A. Schepkin *In its* Ionospheric Res. 1965 p 13–20 refs (See N67-32817 19-13)

The major results of the study of the ionization–recombination processes in the F region of the ionosphere obtained on the basis of the IGY materials are presented. The ionization function in the F region of the ionosphere and the method of evaluation of the ionization–recombination parameters of the F2 layer with the E. C. M. according to the data on the diurnal changes of f_0F2 are briefly discussed. Major results of similar processing of materials of observations from several middle-latitude ionospheric stations are given. On the basis of the obtained results, the main characteristics of changes of the behaviour of the F2 layer in the diurnal and seasonal dependencies are described. Author

N67-32821# Academy of Sciences (USSR). Moscow.
CHEMICAL PROCESSES IN IONOSPHERE
S. P. Yatsenko *In its* Ionospheric Res. 1965 p 21–25 refs (See N67-32817 19-13)

Various possible researches of the chemical processes in the ionosphere are discussed. Results of a study of chemical composition of the ionosphere with a radiofrequency mass spectrometer are presented. Author

N67-32822# Academy of Sciences (USSR). Moscow.
MASS-SPECTROMETER MEASUREMENTS OF NEUTRAL COMPOSITION OF THE EARTH'S ATMOSPHERE AT ALTITUDES FROM 100–430 km
A. A. Pokhynkov *In its* Ionospheric Res. 1965 p 26–40 refs (See N67-32817 19-13)

Results are presented of four experiments which studied the neutral composition of the atmosphere with radio frequency mass spectrometers launched on board the geophysical rockets. Measurements were made in the middle latitudes of the European part of the U.S.S.R. at altitudes from 100 to 210 km in the summer of 1959 and in the autumn of 1960, and at altitudes from 130 to 430 km in the autumn of 1961. Author

N67-32823# Academy of Sciences (USSR). Moscow.
DRIFT RECORDS PROCESSING WITH THE HELP OF CHARACTERISTIC FUNCTION AND CALCULATION OF DEVIATIONS FROM NORMAL IN DISTRIBUTION OF SIGNAL COMPONENT
I. S. Vsekhsviatskaya and Yu. K. Kalinin *In its* Ionospheric Res. 1965 p 41–47 refs (See N67-32817 19-13)

Assuming that the signal, reflected from the ionosphere, is a superposition of the mirror and chaotic components, a processing is undertaken of the drift registrations with the characteristic function method. This method has less limitations than, for instance, the method of nondimensional ratios of envelope moments. It also shows that previous researches allowed systematic overstating of opaqueness of the ionosphere. This overstating occurred because the deviations of the incidental component of the signal from the normal distribution were not considered. Methods are described which provide consideration of such deviation. The physical meaning of the phenomenological parameters of the signal is discussed. Author

N67-32824# Academy of Sciences. (USSR). Moscow.
WIND SYSTEMS IN LOWER IONOSPHERE
E. S. Kazimirovsky *In its* Ionospheric Res. 1965 p 48–70 refs (See N67-32817 19-13)

The data obtained during the IGY–IGC for the D, E and E_s regions of the ionosphere are analyzed with the method of spaced reception with small base and with the method of radar observations of meteor trails. Maps of global distribution of the most probable directions of movement are also presented. The character of diurnal variations of the drift rate depends on the latitude of the place of observations and to a lesser extent of season. The comparison of these variations shows the existence of one system of regular movements in the lower ionosphere. Schemes of the global distribution of parameters of the continuous, diurnal and semi-diurnal components of the zonal and meridional variations of wind rate components are presented, and it is shown that these parameters change with latitude and depend on season. A confirmation is obtained of the hypothesis that the ionization irregularities in the E region and the ionized meteor trails in winter are formed at different altitudes. Author

N67-32825# Academy of Sciences (USSR). Moscow.
DRIFT DETERMINATIONS IN E REGION OF THE IONOSPHERE OVER KHARKOV
Ye. I. Grigorenko and V. I. Taran *In its* Ionospheric Res. 1965 p 71–76 refs (See N67-32817 19-13)

Results of drift measurements in the E region of the ionosphere by the method of spaced reception with small base obtained in 1962 are discussed. A comparison is made with the data received in 1959–60. In 1962 the probable rates of shifting of irregularities considerably exceed the rates obtained in 1959–60, which in winter are 100–120 m/sec, in spring and autumn are 60–80 m/sec, in summer 80–100 m/sec. In 1959–60 the drift was primarily observed in the NE direction. In winter and spring of 1962 the major drift was directed in the SE, in summer in the E, in autumn in the S and SW. A harmonic analysis is made of the results of measurements. Data are also presented illustrating the polarization influence of the entering wave on the drift measurements obtained with simultaneous observations. Recommendations are suggested to exclude the influence of the polarization fade-outs on the drift measurements. Author

N67-32826# Academy of Sciences (USSR). Moscow.
ON RELATIONS BETWEEN IONOSPHERIC MOVEMENTS AND MAGNETIC ACTIVITY
V. D. Kokourov *In its* Ionospheric Res. 1965 p 77–85 refs (See N67-32817 19-13)

A brief survey of papers on the discussion of relations between parameters of small scale ionization irregularities in the ionosphere and geomagnetic activity is presented. The results of an analysis of relations between the drift rates of small scale ionization irregularities in the F, E, and D regions of the ionosphere and geomagnetic activity evaluated by the local K-index are given. The data used are drift measurements taken by the world network of stations for the IGY–IGC period. The dependence is manifested rather weakly in most cases. A prominent connection is observed only at high latitudes. For a number of stations a comparison is made of the drift rates with magnetic activity, evaluated according to the mean amplitude of the geomagnetic field variations at the earth's surface. The obtained results are compared with theoretical suppositions and with results of other researches. The causes of ensuing discrepancies are discussed. Author

N67-32827# Academy of Sciences (USSR). Moscow.
ON THE NATURE AND TIME-SPACE DISTRIBUTION OF IONOSPHERIC DISTURBANCES
E. I. Mogilevskiy, R. A. Zevakina, Ye. V. Lavrova, and L. N. Liakhova *In its* Ionospheric Res. 1965 p 86–93 refs (See N67-32817 19-13)

An analysis is given of planetary distribution of the ionospheric disturbance. It is shown that in the F2 region there exist areas with the greatest ionospheric disturbance which have a tendency to be located in the regions of maximum intensity of the earth's magnetic field. Such distribution of ionospheric disturbance is explained by the flow of magnetosound waves dissipating in the F2 region. A qualitative explanation is given of the two possible ways of propagation of solar proton streams causing anomalous absorption of radiowaves in the polar cap. Author

N67-32828# Academy of Sciences. (USSR). Moscow.
IONOSPHERIC IRREGULAR PHENOMENA AND DISTURBANCES IN HIGH LATITUDES
A. S. Besprozvannaya and G. N. Gorbuschina *In its* Ionospheric Res. 1965 p 94–99 refs (See N67-32817 19-13)

Results are presented of statistical analysis of spatial–time distribution of the main irregular phenomena in the ionosphere of high latitudes: anomalous absorption, sporadic ionization in the E region and disturbances of the F2 layer during the sunlit and dark periods of the day. The results are also given of the analysis of disturbed periods in the ionosphere. The data used in the article were obtained with vertical sounding at 30 stations located to the north of 55° geomagnetic latitude during the IGY period, mainly for 1958. Author

N67-32829# Academy of Sciences (USSR), Moscow.
SOME IONOSPHERIC AND GEOMAGNETIC EFFECTS OF LARGE SOLAR FLARES
G. M. Khocholava *In its* Ionospheric Res. 1965 p 100–103 refs (See N67-32817 19-13)

The results of research on the anomalous absorption in the polar cap, associated with large chromospheric flares on the sun are summarized. The IGY–IGC material is also applied. Author

N67-32831# Academy of Sciences (USSR), Moscow.
MORPHOLOGY AND PROPERTIES OF SPORADIC IONOSPHERIC LAYER E_s ACCORDING TO THE IGY DATA
T. S. Kerblay, S. S. Chavdarov, and Yu. K. Chasovitin *In its* Ionospheric Res. 1965 p 117–128 refs (See N67-32817 19-13)

According to the IGY–IGC materials, the properties of different E_s were studied on a planetary scale. The degree of semi-transparency, the stability of the E_s types in time and space, the distribution of the daily measurements of the f_oE_s and f_bE_s and the dispersion characteristics are discussed. The authors obtained conceptions about daily and seasonal regularities of the E_s types and of their geographical distribution. World charts are drawn of the probability of occurrence of the $f_oE_s>3$ MHz and $f_bE_s>3$ MHz. Author

N67-32833# Academy of Sciences (USSR), Moscow.
RELATIONS BETWEEN IONOSPHERIC AND ATMOSPHERIC DYNAMICS ACCORDING TO THE MATERIALS OF STATIONS IN THE URALS AND SIBERIA, NORTH CAUCASUS AND MIDDLE ASIA DURING THE IGY
V. N. Kessenikh, E. S. Kazimirovsky, and U. A. Novikova *In its* Ionospheric Res. 1965 p 141–145 refs (See N67-32817 19-13)

The ionospheric data of a number of middle-latitudinal stations are compared with solar activity and mean monthly characteristics of the state of the troposphere. It is shown that from year to year uncorrelated changes of maximum ionization of the E2 layer take place, which are followed by regional changes of characteristics of the troposphere and tropopause and by wind changes in the E2 layer. Author

N67-32834# Academy of Sciences (USSR), Moscow.
VISIBLE DISTRIBUTION OF SPORADIC METEOR RADIANTS ACCORDING TO AZIMUTH RADAR OBSERVATIONS
Yu. A. Poupyshev *In its* Ionospheric Res. 1965 p 146–162 refs (See N67-32817 19-13)

The technique for obtaining the visible distribution is described. Variants of exact and approximate solutions of the problem are reviewed. According to the observations in 1959, conducted on the IGC program, the installation with $\lambda=8.7$ m, $\alpha_0=2.9\cdot10^{11}$ el. cm^{-1}, obtained mean monthly distribution of visible radiants. The preliminary results are discussed. Author

N67-32846# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
STRESS AND WAVE PATTERNS IN SOILS SUBJECTED TO DYNAMIC LOADS
R. K. Bernhard Mar. 1967 60 p refs
(CRREL-RR-120; AD-652871) CFSTI: HC $3.00/MF $0.65

The report is divided into four parts: Parts I and II cover investigations of the reliability of shear stress measurements in soils subjected to vibratory loads for biaxial and triaxial systems, respectively. Part I is a summary only (See SIP 21834 for detailed treatment). Part III is a study of three-dimensional principal stress patterns produced in soil subjected to vibratory loads. Part IV is a theoretical analysis of some aspects of soil wave propagation in stratified soil. From the measurements of five shear stresses and one normal stress, the stress distribution of a triaxial system can be determined. In noncohesive soils triaxial stress fields due to vibratory loads can be determined by recording six independent stress components. Sinusoidal force excitation and impact excitation yield time-distance graphs which can be used to determine reflection and refraction techniques in stratified soils. Author (TAB)

N67-32881# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
POSSIBILITY OF STUDYING THE WESTWARD DRIFT BY ARCHEOMAGNETIC DATA [VOZMOZHNOST' IZUCHENIYA ZAPADNOGO DREYFA PO ARKHOMAGNITNYM DANNYM]
S. P. Buristskaya, T. B. Nechayeva, and G. N. Petrova May 1967 10 p refs Transl. into ENGLISH from the book "Nastoyashcheye i Proshloye Magnitnogo Polya Zemli" Moscow, Izd. Nauk, 1965 p 56–61
(ACIC-TC-1159; TT-67-62026; AD-652488) CFSTI: HC $3.00/MF $0.65

The comparison of the curve of secular change of inclination for the Caucasus, encompassing a time interval of about 3000 years, with the curve of change in I for other regions (France, Italy, England, Japan) has made it possible to notice several general regularities which appear especially clearly in the curves relating to a relatively narrow interval of latitudes. In order to support the reality of the noted regularities, supplementary collections of samples were taken from the same latitude belt. The newly taken samples were measured, as in the case of the Caucasian samples, by the method of progressive heatings. The results of measuring the inclinations of samples from Bulgaria lie as a first approximation on the curve for the Caucasus, shifted in phase about 100 years toward our time. This coincidence has a somewhat conventional character, since 100 years is a time interval lying at the limits of error for dating samples of the first millenium of our era. The collection was not large, and hence it did not appear possible to construct an independent curve for Bulgaria. These results, as well as the data of Eotvos for Hungary and the new results of Ye. N. Tarkhov for Leningrad, in comparison with our results and those from abroad, gave the possibility of tracing the time change of inclination for various regions of the earth's surface. Author (TAB)

N67-32901# American Meteorological Society, Boston, Mass.
THERMAL PROPERTIES OF AMPHIBOLES AS A FUNCTION OF ALKALI CONTENT [O ZAVISIMOSTI TERMICHESKIKH SVOISTV AMFIBOLOV OT SODERZHANIIA V NIKH SCHELOCHEI]
A. F. Korzhinskii Bedford, Mass., AFCRL, Feb. 1967 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 3, 1965 p 445–447
(Contract AF 19(628)-3880)
(TR-634; TT-67-61619; AD-650678) CFSTI: HC $3.00/MF $0.65

Some authors hold that amphiboles also contain zeolitic water that is given off in the 400-500C range, which creates a corresponding additional endothermal effect in the temperature diagram. Optical pyrometer studies of 24 specimens of amphiboles of various compositions did not show the presence of zeolitic water in even a single case. The result of these studies of different amphiboles (tremolite-actinolite series, nephrites, common hornblendes, pargasite, and arfvedsonite) was to establish that their thermal properties are largely a function of alkali content. Author (TAB)

N67-32980# RAND Corp., Santa Monica, Calif.
DENSITY AND TEMPERATURE VARIATIONS IN THE INTERVENING LAYER (90-180 KM)
Gerhard F. Schilling May 1967 27 p refs Presented at AMS Symp. on Meteorol. Invest. Above 70 km, Miami Beach, Fla., 31 May–2 Jun., 1967
(P-3698; AD-662197) CFSTI: HC $3.00/MF $0.65

The current extent of our knowledge of the atmospheric structure of the intervening layer is surveyed in terms of the integrated information that model atmospheres are able to provide. A severe test of the accuracy of this knowledge is available from

studies of satellite re-entry and impact predictions. By means of schematic examples, model atmospheres that are essentially only empirical correlations are contrasted with those incorporating physical relations. Their relative applicability to basic and applied studies is discussed, and attention is drawn to such convenient, but probably inappropriate features as monotonic temperature structures, simplified mesopause properties, and fixed boundary conditions. TAB

N67-32968# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
ARECIBO IONOSPHERIC OBSERVATORY Final Report, 1 Feb. 1964–31 Jan. 1967
31 Jan. 1967 148 p refs
(Contract AF 49(638)-1156)
(CRSR-70; AFOSR-67-1114; FR-10; AD-652506) CFSTI: HC $3.00/MF $0.65

The final report summarizes the research at the Arecibo Ionospheric Observatory from 1 Feb. 1964 to 31 Jan. 1967. A table summarizes the accomplishments of the various programs. The ionospheric studies include incoherent backscatter measurements of electron density to 1500 km, derivation of ionic composition and of electron and ion temperatures as a function of height. Important discoveries include the plasma line, the influence of photoelectrons produced at the magnetic conjugate point, and traveling wavelike disturbances. The radar astronomy studies have shown topographical features on Venus and Mercury, the retrograde rotation of Venus with a 249 day period, and the extremely small radar cross section of Jupiter. Surprisingly, Mercury has been found to have a period of rotation 2/3 that of its orbital period. The range-Doppler technique used to map the moon has given resolutions of 5-10 km. In the radio astronomy studies, 70 lunar occultations of celestial radio sources were measured, interplanetary scintillations were studied, and flux densities of a large number of radio sources were determined, as well as the brightness of many ionized hydrogen regions in galactic space. It was concluded that the AIO instrument will exceed the capabilities of other instruments for some time and can be easily improved to operate at much shorter wavelengths. Author (TAB)

N67-32985# Paris Univ. (France).
ATMOSPHERIC AND IONOSPHERIC STUDIES WITH FARADAY RECORDS
In its The Joint Satellite Studies Group Oct. 1966 p 50–92 refs (See N67-32982 19-07)

Reported are a series of papers oriented towards atmospheric and ionospheric studies with Faraday records. Included are papers on the interest of total electron content measurements for the geophysicist; electron content measurements by active satellite during the May 20, 1966 solar eclipse; satellite studies of equatorial F-region irregularities; Faraday rotation studies at 20 megacycles; statistical studies on the development of the total electron content in terms of various parameters; joint reduction of Faraday rotation data from several observatories in the Joint Satellite Studies Group; electron content measurements through S-66 signals in Florence, Italy; large scale ionospheric irregularities as detected by index $\Delta T/T$; ionospheric studies at Nairobi using earth satellites; and field aligned ionization layers observed by means of Faraday rotation of satellite signals. S.C.W.

N67-33036# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
COMPARISON OF THE ACCURACY OF TRIANGULATION, TRILATERATION, AND TRIANGULATION-TRILATERATION [SRAVNENIYE TOCHNOSTI UGLOVOY, LINEYNOY, I LINEYNO-UGLOVOY TRIANGULYATSII]
P. A. Provorov Mar. 1967 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. (Moscow), v. 1, 1960 p 57–64
(ACIC-TC-1207; TT-67-61530; AD-650359) CFSTI: HC $3.00/MF $0.65

The article confronts the problem of examining the possible (from his viewpoint) variations of constructing a geodetic net on the basis of known methods of measuring geodetic quantities. TAB

N67-33117# Naval Research Lab., Washington, D. C.
ABSOLUTE ELECTRICAL FIELD MEASUREMENTS USING FIELD MILLS
Stuart G. Gathman and Eva Mae Trent 26 Apr. 1967 16 p refs
(NRL-6538; AD-652928) CFSTI: HC $3.00/MF $0.65

In order to measure absolute values of electric field, an accurate method of calibration of field meters must be obtained. One purpose of calibration is to relate electric output from an inverted field meter to the true field. One method of calibration allows absolute values of electric field from a flush-mounted field meter. A new way of combining the geometry of the field meter mount and atmospheric space charge results in only a slight improvement in measurement error over a former method of calibration involving only time averages. Nevertheless, the experiment points out that atmospheric space charge affects in a complicated manner measurements made with inverted field mills. Author (TAB)

N67-33163* Geological Survey, Washington, D. C.
ASTROGEOLOGIC STUDIES. PART B: CRATER INVESTIGATIONS Annual Progress Report, 1 Jul. 1965–1 Jul. 1966
Nov. 1966 288 p refs
(NASA Order R-66)
(NASA-CR-87057) CSCL 08G

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11. GEOLOGY OF THE MOSES ROCK INTRUSION, SAN JUAN COUNTY, UTAH T. R. McGetchin p 231–253 refs (See N67-33174 19-13)

N67-33164* Geological Survey, Washington, D. C.
HISTORY AND ORIGIN OF THE FLYNN CREEK CRATER, TENNESSEE Final Report

David J. Roddy *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 1–39 refs (See N67-33163 19-13)

The Flynn Creek structure and its geologic history are described, and it is felt that the crater probably was formed during the Middle Devonian time. Geologic and geophysical data relevant to the origin of the crater are outlined, and hypotheses of the origin are reviewed. The discussion on the cryptovolcanic, or volcanic gas explosion, hypothesis emphasizes the relationship of the crater to regional structure and volcanism and the comparison of the crater with maars and diatremes. For the meteorite impact hypothesis, comparisons are made of the crater with meteorite impact craters, nuclear explosion craters, and chemical explosion craters. Evidence on the similarities of structural deformations of the Flynn Creek crater and known impact craters is considered to indicate an impact origin for the crater. N.E.N.

N67-33165* Geological Survey, Washington, D. C.
GEOLOGY OF THE SIERRA MADRE STRUCTURE, TEXAS Progress Report
H. G. Wilshire *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 41–70 refs (See N67-33163 19-13)

The area of detailed mapping was extended, and new data were obtained on lithology and stratigraphic relations of the Permian rocks exposed at Sierra Madera and in the nearby Glass Mountains. Structural data obtained from records of deep drill holes on and near Sierra Madera indicate that all parts of the structure are raised above the regional trend of the formations identified. Author

N67-33166* Geological Survey, Washington, D. C.
SOME ASPECTS OF THE MANICOUAGAN LAKE STRUCTURE IN QUEBEC, CANADA
Stephen H. Wolfe *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 71–78 refs (See N67-33163 19-13)

Field study on the Manicouagan–Mushalagan Lakes area are presented. Geographic features of the area bounded by the two arcuate semicircular lakes are outlined, and details are given on the geologic composition. A generalized section of monozonite–andesite units exposed at Manicouagan is included. It is felt that petrographic analysis of samples suggest that the structure is a result of the impact of a large meteoritic mass. N.E.N.

N67-33167* Geological Survey, Washington, D. C.
CRATERS PRODUCED BY MISSILE IMPACTS
H. J. Moore *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 79–105 refs (See N67-33163 19-13)

Impact craters produced by projectiles with large kinetic energies are investigated, and the dimensions and characteristics of the craters are compared with those produced by chemical explosives. Craters were produced by missiles with kinetic energies between 2.10×10^{14} and 3.14×10^{15} ergs impacted in dry to moist sand, alluvium, colluvium, and gypsum lake sediments. The materials in and around the craters are divided into six mappable units: target material, thin to discontinuous ejecta, thick ejecta, tilted and broken target material, shattered target material, and slope material. The morphologies and structures are discussed in detail for two craters, and the data for all craters are tabulated. It was found that craters of the same size are produced when the explosives are detonated at shallow depths and the kinetic energy of the missile is the same as the TNT energy equivalent of the explosive. It was also determined that larger blocks may be ejected from larger craters if the rocks are well indurated and relatively unfractured. N.E.N.

N67-33168* Geological Survey, Washington, D. C.
HYPERVELOCITY IMPACT CRATERS IN PUMICE
H. J. Moore and Francis G. Robertson *In its* Astrogeol. Studies, Pt. B, Nov. 1966 p 107–125 refs (See N67-33163 19-13)

Preliminary results indicate that the sum of ejected and fragmented material from craters produced by the impact of hypervelocity projectiles with pumice at velocities between 3.95 and 7.66 km per sec is proportional to the momentum of the projectile (corrected for the ratio of projectile and target densities). This momentum dependence is also suggested in the size distributions of the sum of the ejecta and fragmented pumice from the crater, as well as in the amount of crushed and partly fused pumice in the debris. This momentum dependence may only represent a transition between low-velocity impacts and hypervelocity impacts. The results contrast with those for craters in solid materials such as basalt and metals for which sizes are essentially dependent on the kinetic energy of the projectile. The size distribution and petrography of the pumice debris imply that irreversible energy losses due to new surface and fusion may be the main factors in producing the momentum dependence of the sizes of craters in pumice. Author

N67-33169* Geological Survey, Washington, D. C.
COMPILATION OF DATA ON CRATERS PRODUCED BY EXPLOSIVES
Francis G. Robertson *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 127–134 refs (See N67-33163 19-13)

The data collection and recording is outlined for the new compilation, using a modified format and with the information standardized for recording on punched cards. Examination of the data indicate that: (1) craters in very wet materials may obey different scaling laws than those in dry materials; (2) the difference in crater sizes with respect to moisture content is particularly distinct at energies near 10^{15} ergs; and (3) sizes of craters produced by explosives with energies near 10^{13} ergs are strongly dependent upon cohesion and rock type of the material. Scaling laws, wet and dry materials, and cohesion are further discussed, and data are graphed. N.E.N.

N67-33170* Geological Survey, Washington, D. C.
IMPACT METAMORPHISM
E. C. T. Chao *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 135–167 refs (See N67-33163 19-13)

Impact metamorphism is investigated to establish diagnostic criteria for distinguishing craters of meteorite impact origin from circular structures of other origins. The materials studied were collected from Arizona, southern Bavaria, Ghana, Saudi Arabia, and Australia. Diagnostic petrographic criteria are discussed with respect to unique microstructures, selective phase transitions, formation of vitreous phases without evidence of viscous flow or vesiculation, occurrences of high pressure polymorphs, and evidence of extremely high temperature. Ejecta from craters are studied to determine the sequence of phase changes of a single mineral species, and to observe textural and chemical changes of rock types resulting from different pressures and temperatures. The shock equation of the state of crystalline rocks, and the corresponding phase transition, peak pressures, and residual temperatures are mentioned. The importance of investigating metamorphic features in meteorites and tektites for the interpretation of lunar photographs and for the future study of lunar samples is indicated. N.E.N.

N67-33171* Geological Survey, Washington, D. C.
NICKEL–IRON SPHERULES FROM THE AOUELLOUL GLASS OF MAURITANIA, AFRICA
E. C. T. Chao, E. J. Dwornik, and Celine W. Merrill *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 169–180 refs (See N67-33163 19-13)

Spherules embedded in Aouelloul glass were analyzed to determine their terrestrial or extraterrestrial origin. Thin wafers were examined microscopically, optically, and with X-rays and an electron microprobe. The nickel and iron contents were determined to be consistent with meteoritic origin, and it is concluded that the Aouelloul crater is a genuine meteorite crater. The glass

composition was found to be nearly identical with the Zii sandstone underlying the crater, and it is concluded that the glass is an impactite of terrestrial origin and not a tektite. N.E.N.

N67-33172* Geological Survey, Washington, D. C.
LARGE-SCALE PLANE WAVE SHOCK EXPERIMENTS DESIGNED FOR SAMPLE RECOVERY
T. J. Ahrens, D. D. Kaough (Stanford Res. Inst., Menlo Park, Calif.), and D. J. Milton *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 181–187 refs (See N67-33163 19-13)

An experimental assembly for producing a planar shock wave and an associated relatively planar particle velocity flow field over an area of nearly half a square meter is described. Tests of the assembly are briefly discussed, and problem areas identified. A site was selected for field experiments on semi-infinite rock target in which shock can dissipate without reflections, simulating meteoritic impact on planetary surfaces. N.E.N.

N67-33173* Geological Survey, Washington, D. C.
INFLUENCE OF STRESS HISTORY ON LOW-TEMPERATURE THERMOLUMINESCENCE OF HALITE
Carl H. Roach *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 189–230 refs (See N67-33163 19-13)

Experimental studies are reported which were undertaken to determine if the thermoluminescence characteristics of halite are altered by shock or stress event. Details are presented on the low temperature glow curve and autoluminograph techniques, and on the laboratory procedures. Samples were taken from the Dribble project (Salmon) site in Mississippi, where triaxial compression tests were conducted, and also from the Gnome project site in New Mexico, where a nuclear device was detonated. Results on the thermoluminescence initiation, and on the distribution, intensity, and plastic deformation are discussed. It is concluded that thermoluminescence techniques have potential application to rock mechanics and related geological problems, and to mapping the three-dimensional extent of halite which is plastically deformed adjacent to underground nuclear explosions. N.E.N.

N67-33174* Geological Survey, Washington, D. C.
GEOLOGY OF THE MOSES ROCK INTRUSION, SAN JUAN COUNTY, UTAH
Thomas R. McGetchin *In its* Astrogeol. Studies, Pt. B Nov. 1966 p 231–253 refs (See N67-33163 19-13)

The Moses Rock intrusion was studied as a possible analog to the subsurface geology of lunar rilles, and the details on the structure of the dike are discussed and presented in maps. The lithologically distinct breccia units are described as mixtures of kimer kimberlite–serpentine breccia, inclusions of Precambrian metamorphic and igneous rock fragments, and inclusions of sedimentary rocks. Graphs of particle size distributions are included. The inferred history of emplacement is illustrated and briefly discussed. N.E.N.

N67-33242# Environmental Science Services Administration, Boulder, Colo.
APPLICATION OF STATISTICAL ESTIMATION TECHNIQUES TO GROUND-BASED PASSIVE PROBING OF THE TROPOSPHERIC TEMPERATURE STRUCTURE Final Report
E. R. Westwater and Otto Nesil Strand Apr. 1967 92 p refs
(IER-37-ITSA-37; AD-652697) CFSTI: HC $3.00/MF $0.65

The theory of radiative transfer in the microwave region is discussed. A method for the numerical solution of a Fredholm integral equation of the first kind is derived and illustrated. A least-squares analysis of microwave absorption data to determine line width for water vapor and oxygen is presented. Calculations of the error covariance matrix and quality-criterion values to be expected when the probing for the tropospheric temperature structure from microwave emission measurements are presented. TAB

N67-33245*# Northwestern Univ., Evanston, Ill.
FORTRAN IV PROGRAMS TO DETERMINE SURFACE ROUGHNESS IN TOPOGRAPHY FOR THE CDC 3400 COMPUTER
R. D. Hobson 1 Aug. 1967 30 p refs
(Grant NGR-14-007-027)
(NASA-CR-87323; Rept.-10) CSCL 08G

Current uses of remote sensing apparatus for geologic investigation place new demands upon types of information gathered by the field geologist. One new area of field investigation is surface roughness. Several quantitative parameters for describing three aspects of surface roughness: comparison of surface areas, frequency distribution of surface irregularities, and orientation of normals to surfaces are presented. Mathematical methodologies for computing parameters are described. Three CDC 3400 Fortran IV programs for computing parameters are listed along with detailed operating instructions. Data are used to illustrate typical uses of surface roughness parameters. Author

N67-33263*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DIURNAL AND SEASONAL-LATITUDINAL VARIATIONS IN THE UPPER ATMOSPHERE
Luigi G. Jacchia and Jack W. Slowey 6 Jun. 1967 42 p refs
(Grant NsG-87-60)
(NASA-CR-87278; SAO Special Rept.-242) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The variations with solar and geomagnetic activity have been eliminated by the use of appropriate models, and the diurnal variation has been isolated in the densities derived from the drag of seven artificial satellites with perigees between 250 and 650 km. An analysis of the diurnal variations leads to the following conclusions: (1) Contrary to previous suggestions, the diurnal bulge does migrate in latitude in phase with the subsolar point at all heights. (2) The diurnal bulge peaks at 2 p.m. local solar time (LST) irrespective of solar activity; the minimum density occurs between 3 and 4 a.m. (3) The amplitude of the diurnal variation seems to fluctuate in a manner that cannot be entirely accounted for by variations in solar activity. (4) The significant high-latitude residuals from the diurnal-variation model observed on the drag of Explorer 19 and Explorer 24 may be explained by the formation of exospheric heights of a region of greater helium density above the poles during the winter months, caused by a seasonal variation in the height of the turbopause. Author

N67-33281# National Research Council of Canada, Ottawa (Ontario).
PRINCIPLES OF GEOCRYOLOGY (PERMAFROST STUDIES). PART II. ENGINEERING GEOCRYOLOGY. CHAPTER XIII. NEW AND IMMEDIATE PROBLEMS IN ENGINEERING GEOCRYOLOGY
N. I. Saltykov 1967 17 p refs Transl. into ENGLISH from the Russian
(NRC-TT-1276; TT-67-62059; AD-652775) CFSTI: HC $3.00/MF $0.65

Report lists current existing gaps in engineering research and practice related to permafrost problems. New problems arising in controlling the thermal and mechanical interactions between engineering structures and the ground in permafrost regions are discussed. TAB

N67-33294# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
A TECHNIQUE FOR SOLVING THE GENERAL REACTION-RATE EQUATIONS IN THE ATMOSPHERE
Thomas J. Kaneshes Apr. 1967 148 p refs *Its* Environmental Res. Papers No. 263
(AFCRL-67-0221; AD-654010) CFSTI: HC $3.00/MF $0.65

With the availability of numerical techniques for solving an extensive set of nonlinear differential equations and high-speed computers for performing the calculations, interest in solving the unrestricted reaction-rate equations is growing among ionospheric researchers. In view of this a refinement is given of the techniques previously developed in PB-163 071 and AD-424 173. The computer code is written to solve the photochemical behavior of 15 atmospheric species; these species are electrons, O(-), O2(-), O3(-), NO2(-), O(+), O2(+), N2(+), NO(+), NO, N, NO2, O3, N2O, and O. Built into the code are 168 reactions that can conceivably take place among these constituents. Several examples of the results obtained using the code are presented, including the buildup of ionization from zero concentrations at altitudes in the D and E regions and the deionization of an atmosphere with high initial electron densities. The diurnal variation of the atmospheric constituents is also presented along with profiles for the above-mentioned species from 60 km to 120 km. The computer codes are included in their entirety with complete explanations on their usage. Author (TAB)

N67-33358*# Volt Technical Corp., Washington, D. C.
SOLAR WIND AND TEMPERATURE FIELD OF THE TROPOSPHERE [SOLNECHNYY VETER I TEMPERATURNOYE POLE TROPOSFERY]
R. V. Smirnov 10 Aug. 1967 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofizika (Moscow), v. 175, no. 1, 1967 p 76–79
(Contract NAS5-12487)
(NASA-CR-87185; ST-STR-AM-10635) CFSTI: HC $3.00/MF $0.65 CSCL 04A

New possibilities are described for tracing solar–terrestrial relationships by way of direct measurements of solar plasma fluxes with the aid of rockets and satellites and comparison of data on solar wind velocities with air temperatures of the near-ground layer is given. Author

N67-33398# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
THE INTERFACE BETWEEN ICE AND SILICATE SURFACES
Duwayne M. Anderson Mar. 1967 39 p refs
(CRREL-RR-219; AD-653812) CFSTI: HC $3.00/MF $0.65

Experiments have been conducted with a particular layer lattice silicate, montmorillonite, in order to study the interaction of water and ice with silicate surfaces. The structural features of this class of silicate minerals are described, and other aspects which have a particular bearing on interfacial phenomena are discussed. Emphasis is placed on the nature of water and aqueous solutions, mechanisms of clay-water interaction, physical and thermodynamic properties of clay-adsorbed water, freezing point depression and supercooling, the existence of unfrozen interfacial water, spatial distribution of unfrozen water, the nature of the ice phase, and phase relationships. Author (TAB)

N67-33403# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE QUESTION OF CALCULATIONS OF THERMAL RADIATION OF THE ATMOSPHERE
Khel'gi Niylisk 28 Mar. 1967 46 p refs Transl. into ENGLISH from Issled. Pofiz. Atm. Akad. Nauk Est. SSR, Inst. Fiz. i Astron. (Tartu), no. 2, 1960 p 87–114
(FTD-MT-65-569; AD-653511) CFSTI: HC $3.00/MF $0.65

A study of radiation monographs based on different principles would enable clarifying the cause of divergent results and attempting the evaluation of the advantages and disadvantages of individual monographs. By using aeroclimatic data for various global zones, an attempt is made to obtain average typical data about the movement of thermal radiation fluxes at different latitudes and heights in the troposphere. TAB

N67-33406 University Coll., London (England). Dept. of Physics.
DIURNAL AND SEMI-DIURNAL S–N WIND COMPONENTS IN THE UPPER ATMOSPHERE DERIVED FROM ROCKET MEASUREMENTS
G. V. Groves 1967 22 p refs
CFSTI: HC $3.00/MF $0.65

S–N wind components from 30 to 70 km during the summer months at eleven launching sites close to 30° latitude were analyzed for diurnal and semidiurnal variations. Results are presented of the amplitudes and phases of these components and also of the nondiurnal, i.e., summer seasonal, component. With Adelaide meteor wind data and an analysis of rawinsonde data at the Azores amplitudes and phases can be presented from 0 to 100 km. A particular feature of the results is an amplification of the diurnal component and a reduction of the semidiurnal component in the 50 km region. Author

N67-33409*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CIRCULATION FEATURES OF THE STRATOSPHERE DERIVED FROM RADIOMETRIC TEMPERATURE MEASUREMENTS WITH THE TIROS VII SATELLITE
James S. Kennedy and William Nordberg Mar. 1967 38 p refs
(NASA-TM-X-55859; X-620-67-134) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Measurements of radiation emitted by atmospheric carbon dioxide at 15 microns were performed with the Tiros VII satellite. These measurements describe temperature patterns in the lower stratosphere. Temperature patterns covering a quasi-global zone (65°N–65°S) are investigated for the period June 1963–November 1964. The satellite observations reveal large scale circulation features of the stratosphere, particularly during the late winter breakdown periods. The salient feature in the Southern Hemisphere, during both late winters of 1963 and 1964, is the occurrence of a warm cell in the vicinity of Australia. This implies a deflection of the initially circumpolar vortex towards the eastern Pacific. In the Northern Hemisphere, winter is characterized by the well known warm cell over the Aleutian Islands with the vortex displaced towards the Atlantic. The Australian and North Pacific warm cells form the nucleus of the springtime warmings which then spread zonally over the entire Southern and Northern Hemisphere, respectively. A quantitative Fourier analysis of the temperature variance along high latitude circles leads to the conclusion that there is considerable transport of ozone and heat by horizontal eddies in both hemispheres during winter. Disturbances in the zonal circulation during that period are predominantly of wave number one. During summer wave number zero prevails. Author

N67-33411# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
ACOUSTICAL AND METEROLOGICAL DATA REPORT SOTRAN I AND II
R. D. H. Low, W. R. Nordquist, J. W. Coffman, A. H. Breeland, Jr., Ricardo Pena et al Nov. 1966 253 p refs
(ECOM-5094; AD-653017) CFSTI: HC $3.00/MF $0.65

Meteorological and acoustical data acquired from Sotran I and II are presented. The monitoring sites, instrumentation, and field operations are described. Author (TAB)

N67-33450 Joint Publications Research Service, Washington, D. C.
SCIENTIFIC RESEARCH GOALS IN GEODESY AND CARTOGRAPHY
A. Sh. Tatevyan 21 Jul. 1967 10 p Trans. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 10, Oct. 1966 p 3–8
(JPRS-41940; TT-67-32571) CFSTI: $3.00

Theoretical and practical geodetic studies are envisioned for the next five-year period, including developing of new geodetic

and gravimetric precision instruments and determination of conditions for their advantageous use. Precision leveling and vertical motions of the earth's crust will be studied, as will be the use of computers for processing and storing geodetic data. Cartographic training and map-making editing procedures will be improved, and appropriate Russian dictionaries will be compiled. M.W.R.

N67-33467# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

ARGON ACTIVATION ANALYSIS: APPLICATION TO DATING BY THE POTASSIUM–ARGON METHOD [ANALYSE PAR ACTIVATION DE L'ARGON: APPLICATION A LA DATATION PAR LA METHODE POTASSIUM–ARGON]

Patrice Dumesnil (Ph.D. Thesis—Paris Univ., Orsay) 1967 70 p refs In FRENCH
(CEA-R-3100)

Activation analysis using ^{40}Ar was applied to rock-dating by the K–Ar method. Argon is extracted from the sample, purified, activated to saturation in a flux of 2×10^{13} neutrons/cm^2/sec^{-1}, and measured by gamma spectroscopy. The sensitivity obtained is such that it is possible to measure amounts of argon corresponding to an age of a few thousand years only. However, since it was not possible to measure the amount of pollution of radiogenic argon by atmospheric argon with any accuracy, the measurable age limit is of the order of millions of years. The method was applied to basalts from the Mont–Dore region. The results obtained are in fairly good agreement with geological, stratigraphic, and paleomagnetic data. Author (NSA)

N67-33469# International Atomic Energy Agency, Vienna (Austria).

TRITIUM AND OTHER ENVIRONMENTAL ISOTOPES IN THE HYDROLOGICAL CYCLE

1967 92 p refs *Its* Tech. Repts. Ser. No. 73 CFSTI: HC $3.00/MF $0.65

A review is presented of the environmental isotopes and their role in the investigation of the hydrosphere. Data on the distribution of the environmental isotopes which are capable of being transported through the atmosphere and of migration through the terrestrial phases of the hydrological cycle are given. Areas of investigation include ground–water recharge, velocity of down-gradient flow, interrelation between surface and ground-waters in river basins, infiltration into soil, and flow patterns in karstic terrains. Surveys of stable isotopes in precipitation are reported, oceanographic applications of cosmic ray and fallout isotopes are shown, and advances in techniques for the collection and analysis of isotopic samples are enumerated. Tables are included for tritium concentrations in Europe and the Mediterranean, Africa and the surrounding ocean areas, South Central Asia and the Indian Ocean, Eastern Asia and the Pacific, and North and South America. C.T.C.

N67-33470# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

TRITIUM IN PRECIPITATION AT CANADIAN SITES, 1953–1963

R. M. Brown *In* Intern. Atomic Energy Agency Tritium and Other Environ. Isotopes in the Hydrol. Cycle 1967 p 71–75 refs (See N67-33469 19-13)

Analytical procedures, data validity, collection station operations, and storm-to-storm fluctuations are briefly discussed in a program for determining tritium content in precipitation. Included are a table showing interlaboratory comparisons of data obtained at Ottawa, a map of peak tritium concentrations, a graph showing deviation of tritium concentration from the mean versus depth of air mass traversed by precipitation, and a map of tritium deviations as related to air mass trajectories. C.T.C.

N67-33471# Johns Hopkins Univ., Baltimore, Md.

COMMENTS ON THE WATER CYCLE OF THE ATMOSPHERE AND ITS MEASUREMENT

G. S. Benton *In* Intern. Atomic Energy Agency Tritium and Other Environ. Isotopes in the Hydrol. Cycle 1967 p 76–78 (See N67-33469 19-13)

An examination is made of the way in which quantities are obtained in direct measurements of the atmospheric vapor flux. An equation for the flux of water in vapor form at any point in the atmosphere is formulated, along with an expression for the divergence of vapor flux. It is noted that the water cycles of the atmosphere are closely related to the cycles of tritium and of the stable isotopes of oxygen, and that as more information on the concentrations and movement of various radioactive isotopes becomes available, it should be possible to use these data to strengthen the understanding of both phenomena. C.T.C.

N67-33472# Stockholm Univ. (Sweden). International Meteorological Inst.

HISTORY OF THE MAJOR PULSES OF TRITIUM IN THE STRATOSPHERE

E. Eriksson *In* Intern. Atomic Energy Agency Tritium and Other Environ. Isotopes in the Hydrol. Cycle 1967 p 79–80 refs (See N67-33469 19-13)

A brief summary is presented of a paper concerned with the major pulse history of tritium in the stratosphere. Topics mentioned include tritium from nuclear tests since 1952, the transport of moisture and tritium in the atmosphere, and the deposition of tritium over land and oceans. C.T.C.

N67-33473# New Zealand. Dept. of Scientific and Industrial Research, Wellington.

TRITIUM IN SOUTHERN HEMISPHERE PRECIPITATION, 1955–1964

C. B. Taylor *In* Intern. Atomic Energy Agency Tritium and Other Environ. Isotopes in the Hydrol. Cycle 1967 p 81 ref (See N67-33469 19-13)

A paper concerned with tritium content in Southern Hemisphere precipitation is briefly summarized. It is reported that the following topics are covered: deposition of HTO, variations of HTO fallout, fallout of tropospheric and stratospheric thermonuclear HTO, and the effects of continental environment on measurements. C.T.C.

N67-33478*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE MAGNETOSPHERIC TEMPERATURE DISTRIBUTION

H. G. Mayr and H. Volland Jun. 1967 18 p refs
(NASA-TM-X-55871; X-621-67-291) CFSTI: HC $3.00/MF $0.65
CSCL 04A

Due to the low electron density and the large mean free path in the magnetosphere it is necessary to modify the equation of the heat flux parallel to the magnetic field. It is shown that the heat conductivity is effectively decreased by this modification, which can explain the high temperatures in the upper magnetosphere observed by Serbu and Maier. Since the effective perpendicular heat conductivity may be enormously enhanced due to plasma turbulence, it is then conceivable that both conductivities may be of comparable magnitude. This suggests a heat flux from the interplanetary space through the magnetosphere into the thermosphere, which could also affect the magnetospheric electron temperature distribution. Author

N67-33500# Johannes-Gutenberg-Universitat, Mainz (West Germany). Meteorologisch-Geophysikalisches Inst.

RESEARCH ON ATMOSPHERIC OPTICAL RADIATION TRANSMISSION Final Report, 1 Dec. 1965–30 Nov. 1966

K. Bullrich, E. de Bary, W. Blaettner, R. Eiden, G. Haenel et al Jan. 1967 83 p refs
(Contract AF 61(052)-595)
(AFCRL-67-0207; AD-653757) CFSTI: HC $3.00/MF $0.65

Measurements and computations of the spectral sky radiation close to the sun. Measurements of spectral sky radiation at Haleakala, Maui, Hawaii. Theoretical interpretation of experimental data on the distribution of the spectral sky radiation. Measurements of the reflectivity of calcareous soil for neutral and polarized light. The real part of the mean index of refraction and the mean density of samples of atmospheric aerosol particles. Degree of polarization of twilight intensity. Author (TAB)

N67-33522# Imperial Coll. of Science and Technology, London (England).
SUGGESTIONS FOR MAGNETOSPHERIC EXPERIMENTS
J. J. Quenby Paris, ESRO, May 1966 14 p refs Presented at the ESRO Colloq. on Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes, Stockholm, 16–18 Nov. 1965 (ESRO-SN-29) CFSTI: HC $3.00/MF $0.65

The different classes of magnetospheric problems are distinguished and several possible projects are discussed. The first is a high inclination eccentric orbit satellite with an apogee of 20 to 25 earth radii which could be used to investigate (1) the extent of the shock boundary and transition regions at high latitudes, (2) the neutral points on the magnetospheric boundary, and (3) particle accelerations in the high-latitude transition region. The second is a proposal for two close satellites launched into the tail to observe the position of the neutral sheet as a function of time and the spatial extent of the island electron fluxes, and in addition the particle acceleration with respect to the magnetic field. The last proposal is for a satellite to study the interaction of VLF and hydromagnetic waves with trapped particles. It is suggested that the two-satellite system seems much more likely to yield additional fundamental information than the other proposals. Author (ESRO)

N67-33529# Ohio State Univ., Research Foundation, Columbus.
GEODETIC CONTROL WITHOUT TRIANGULATION, TRILATERATION, OR GRAVITY DATA AND GRAVIMETRIC REDUCTION OF LEVELLING Interim Technical Report, Sep. 1966–Feb. 1967
John Badekas and Ivan Mueller Mar. 1967 7 p
(Contract DA-44-009-AMC-507(X))
(ITR-6; AD-653777) CFSTI: HC $3.00/MF $0.65

The report shows the progress made during the months of September 1966 through February 1967, on Task No. 1 of the contract. The work on Task No. 1 is progressing satisfactorily. The field work was carried out and the computation process has been started. Author (TAB)

N67-33533# Rice Univ., Houston, Tex.
NEW PARTICLE MEASUREMENTS BY A SATELLITE IN A HIGHLY-ECCENTRIC POLAR ORBIT
Brian J. O'Brien Paris, ESRO, May 1966 25 p refs Presented at the ESRO Colloq. on Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes, Stockholm, 16–18 Nov. 1965 (ESRO-SN-30) CFSTI: HC $3.00/MF $0.65

The need for a high-altitude high-inclination satellite, instrumented with magnetometer, plasma detectors, and detectors of energetic particles, to make experimental measurements in regions of the magnetosphere as yet unexplored is discussed. Such a satellite may be the first to explore the neutral points and is therefore referred to as Neutral 1. The orbit also offers the optimum variety of phenomena to be explored, with the additional advantage that the characteristics of each phenomenon can be compared one with the other and the interrelation of these phenomena deduced. Neutral 1 would provide unique opportunities to investigate many unknown phenomena, such as the origin and energization of the particles that cause auroras and those that constitute Van Allen radiation. The lecturer emphasizes the urgency for such a satellite and expresses the view that it should certainly be operational by sunspot maximum (1969). Author (ESRO)

N67-33538# Royal Inst. of Tech., Stockholm (Sweden).
DESIRABLE MAGNETIC FIELD MEASUREMENTS IN THE HIGH-LATITUDE MAGNETOSPHERE
R. Bostroem Paris, ESRO, May 1966 17 p refs Presented at the ESRO Colloq. on Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes, Stockholm, 16–18 Nov. 1965 (ESRO-SN-25) CFSTI: HC $3.00/MF $0.65

It is desirable to make satellite measurements of magnetic disturbances from currents flowing along the magnetic field lines from the outer magnetosphere to the auroral zone. Such measurements could prove or disprove the validity of different models of the auroral current system. Author (ESRO)

N67-33635# Ohio State Univ. Research Foundation, Columbus.
OPTIMUM SMOOTHING OF AERIAL GRAVITY MEASUREMENTS
Helmut Moritz Mar. 1967 61 p refs
(Contract AF 19(628)-5701)
(SR-13; AFCRL-67-0169; Rept.-81; AD-654008) CFSTI: HC $3.00/MF $0.65

The smoothing of aerial gravimeter records is investigated theoretically using the theory of stationary stochastic processes (time series). Two methods of optimum filtering are considered: first, least-squares filtering, due to Norbert Wiener, where the r.m.s. error is minimized absolutely; and second, equal-spectrum filtering, where the r.m.s. error is minimized subject to the condition of least distortion as expressed by preservation of spectrum. The equal-spectrum method seems to be more appropriate for aerial gravimetry because of the high noise level and has a considerable practical advantage. Emphasis is on digital computation, for which practical formulas are given; analog computation by means of electric networks is outlined. Author (TAB)

N67-33660# Paris Univ. (France).
IONOSPHERIC RESEARCHES USING SATELLITES Progress Report, 1 Jan. 1965–31 Mar. 1967
Etienne J. Vassy 15 Apr. 1967 49 p refs
(Contract AF 61(052)-761)
(PR-13; AFCRL-67-0337; AD-653983) CFSTI: HC $3.00/MF $0.65

Contents: Analysis of a programmed Faraday total-electron at two near frequencies; Errors in total electron content using the differential Faraday method; The interest of total electron content measurements for the geophysicist; Statistical account of the development of the total electron content in terms of various parameters; Study on refraction by computation of the differential Doppler and Faraday effects at 20 and 40 Mc/s; Test-rig for digital measurement of Faraday-zeo time intervals; Experimental device for the measurement of the Differential Doppler Fizeau effect of the artificial satellites; Experimental methods of ionospheric absorption measurements by means of artificial earth satellites. TAB

N67-33664# Rhode Island Univ., Kingston.
SEISMIC DIFFRACTION BY CRUSTAL DISCONTINUITIES Final Report, 1 Jan. 1962–30 Sep. 1966
Julius Kane 15 Jan. 1967 101 p refs
(Contract AF 19(628)-319; ARPA Order 180-62; ARPA Order 292-12; Proj. Vela-Uniform)
(AFCRL-67-0122; AD-653582) CFSTI: HC $3.00/MF $0.65

The report describes the research contributions of a group studying theoretical problems of seismic diffraction at the University of Rhode Island. These problems are described in simplified terms and formulations which are mathematically tractable and still relevant to realistic crustal structures. Reprints of papers describing the methods are included as appendices in the report. Author (TAB)

N67-33667# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
GEOMAGNETIC RESEARCHES, NO. 8
1966 123 p refs In RUSSIAN; ENGLISH summaries CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE METHOD OF ANALYTICAL REPRESENTATION OF "INSTANTANEOUS" FIELDS OF MAGNETIC VARIATIONS A. D. Bazarhapov, V. M. Mishin, E. I. Nemtsova, and M. L. Platonov p 5–22 refs (See N67-33668 19-13)

2. SELECTION OF THE SPECTRUM OF THE LEGENDRE POLYNOMS APPROXIMATING THE OBSERVED Sq-FIELD V. M. Mishin and A. D. Bazarzhapov p 23–30 refs (See N67-33669 19-13)

3. MEAN Sq-FIELDS ACCORDING TO THE DATA FOR SEPTEMBER 1958 E. B. Afraimovich, A. D. Bazarzhapov, V. M. Mishin, E. I. Nemtsova, N. K. Osipov, et al p 31–51 refs (See N67-33670 19-13)

4. UT-COMPONENT IN THE Sq VARIATIONS ACCORDING TO THE IGY DATA E. I. Nemtsova p 52–62 refs (See N67-33671 19-13)

5. DIURNAL CHANGES OF MAGNETIC ACTIVITY ACCORDING TO THE IGY DATA (DISTURBED DAYS) A. D. Bazarzhapov, V. M. Mishin, E. I. Nemtsova, and O. A. Troshichev p 63–81 refs (See N67-33672 19-13)

6. DIURNAL CHANGES OF MAGNETIC ACTIVITY ACCORDING TO THE IGY DATA (QUIET DAYS) O. A. Troshichev p 82–88 refs (See N67-33673 19-13)

7. COMPARISON OF COEFFICIENTS OF THE HARMONIC ANALYSIS OF DIURNAL VARIATIONS OF K-INDICES AND EQUIVALENT AMPLITUDES V. D. Urbanovich p 89–93 refs (See N67-33674 19-13)

8. DISTRIBUTION OF MAGNETIC ACTIVITY IN HIGH LATITUDES V. M. Mishin, O. A. Troshichev, and V. D. Urbanovich p 94–101 refs (See N67-33675 19-13)

9. ON TIME-SPACE DISTRIBUTION OF GEOMAGNETIC DISTURBANCE V. M. Mishin p 102–104 refs (See N67-33676 19-13)

10. PLOTTED CATALOGUE OF MAGNETIC STORMS, 1958 P. A. Maisuradze, V. M. Mishin, A. V. Sergeev, and I. E. Nachasova p 105–109 refs (See N67-33677 19-13)

N67-33668# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE METHOD OF ANALYTICAL REPRESENTATION OF "INSTANTANEOUS" FIELDS OF MAGNETIC VARIATIONS
A. D. Bazarhapov, V. M. Mishin, E. I. Nemtsova, and M. L. Platonov *In its* Geomagnetic Res., No. 8 1966 p 5–22 refs (See N67-33667 19-13)

The method of spherical analysis of Sq-field given by the "instantaneous" values of X, Y, Z on the existing network of magnetic stations is described. The method was tested by the data of the world network of stations for September 1958. It is shown that the so-called unpotential part of Sq-field does not exceed the errors of calculations. Real changes of Sq-field with UT are several times greater that the errors of calculations. Author

N67-33669# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
SELECTION OF THE SPECTRUM OF THE LEGENDRE POLYNOMS APPROXIMATING THE OBSERVED Sq-FIELD
V. M. Mishin and A. D. Bazarzhapov *In its* Geomagnetic Res., No. 8 1966 p 23–30 refs (See N67-33667 19-13)

The method of the optimal choice of spectrum of spheric functions approximating Sq-field given for the world network of magnetic stations is discussed. The criterion for the choice of the spectrum is suggested providing minimization of coefficient errors of the approximating series. Practical applications of the method are briefly described. Author

N67-33670# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
MEAN Sq-FIELDS ACCORDING TO THE DATA FOR SEPTEMBER 1958
E. B. Afraimovich, A. D. Bazarzhapov, V. M. Mishin, E. I. Nemtsova, N. K. Osipov et al *In its* Geomagnetic Res., No. 8 1966 p 31–51 refs (See N67-33667 19-13)

Results of a spherical harmonic analysis of the Sq-fields for September 1958 are presented. The analysis is accomplished by the usual method assuming stability of Sq-systems during the 24 hours. It is shown that this method, despite the large amount of applied statistical material, provides lesser accuracy of calculations. Sq-current systems are given and plotted according to the data of three different longitudinal sectors (Europe, Asia, America). Several new regularities are noted of the changes of zero isolines I and UT-changes of Sq-currents. Author

N67-33671# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
UT-COMPONENT IN THE Sq VARIATIONS ACCORDING TO THE IGY DATA
E. I. Nemtsova *In its* Geomagnetic Res., No. 8 1966 p 52–62 refs (See N67-33667 19-13)

Regular changes of UT-characteristics of the planetary Sq-field were revealed: configuration of current vortexes (place of foci and strength of current. The width of foci changes with UT to value $\approx 20°$ and the strength of current, depending on the season, to value 25% from the mean diurnal level. A number of mechanisms which cause UT-changes of the quiet geomagnetic field, including the mechanism related to the solar wind, are described. Author

N67-33672# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
DIURNAL CHANGES OF MAGNETIC ACTIVITY ACCORDING TO THE IGY DATA (DISTURBED DAYS)
A. D. Bazarzhapov, V. M. Mishin, E. I. Nemtsova, and O. A. Troshichev *In its* Geomagnetic Res., No. 8 1966 p 63–81 refs (See N67-33667 19-13)

The diurnal variations of the magnetic activity level according to the data of the world network of IGY stations, are studied. It is shown that the diurnal variation includes the known LT-component and the UT-component, and is considered for all latitudes. The changes of magnetic activity level proportional to $\sqrt{\cos \chi}$, where χ is the zenith angle of the sun, are presented. For the UT-component the noncoincidence effect of the diurnal rotation of the excentric earth dipole is described. It is concluded that there exist two quasi-circular zones of maximum of conductivity of disturbed ionosphere near latitudes $\Phi = 63°–65°$ and $\Phi = 75°$. Author

N67-33673# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
DIURNAL CHANGES OF MAGNETIC ACTIVITY ACCORDING TO THE IGY DATA (QUIET DAYS)
O. A. Troshichev *In its* Geomagnetic Res., No. 8 1966 p 82–88 refs (See N67-33667 19-13)

It is shown that the structure of diurnal variation on quiet days has the same character as on the disturbed. The latitude changes of parameters LT- and UT-components are discussed. The symmetric part of the UT-component is interpreted as describing the changes of the magnetic activity level caused by the rotation of geomagnetic dipole. Author

N67-33674# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
COMPARISON OF COEFFICIENTS OF THE HARMONIC ANALYSIS OF DIURNAL VARIATIONS OF K-INDICES AND EQUIVALENT AMPLITUDES

V. D. Urbanovich *In its* Geomagnetic Res., No. 8 1966 p 89–93 refs (See N67-33667 19-13)

The parameters of harmonic analysis for diurnal variations of K-indices (Sa(K)) and of the equivalent amplitudes (Sa(R)) are compared. It is shown that the phases of the basic harmonics Sa(K) and Sa(R) coincide with the accuracy up to the value ≈5°; latitude changes of amplitudes of these harmonics in Sa(K) and Sa(R) are found to be analogous. Author

N67-33675# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

DISTRIBUTION OF MAGNETIC ACTIVITY IN HIGH LATITUDES

V. M. Mishin, O. A. Troshichev, and V. D. Urbanovich *In its* Geomagnetic Res., No. 8 1966 p 94–101 refs (See N67-33667 19-13)

The latitude distribution of the mean level of magnetic activity is analyzed. It is concluded that two quasi-circular zones of maximum activity exist near $\Phi = 63°–65°$ and $\Phi = 78°$. Author

N67-33676# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON TIME-SPACE DISTRIBUTION OF GEOMAGNETIC DISTURBANCE

V. M. Mishin *In its* Geomagnetic Res., No. 8 1966 p 102–104 refs (See N66-33667 19-13)

A simple scheme generalizing the major regularities of diurnal and latitude changes with the level of magnetic activity is described. Author

N67-33677# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

PLOTTED CATALOGUE OF MAGNETIC STORMS, 1958

P. A. Maisuradze, V. M. Mishin, A. V. Sergeev, and I. E. Nachesova *In its* Geomagnetic Res., No. 8 1966 p 105–109 refs (See N67-33667 19-13)

According to continuous data for 1958 the curves of time changes of the planetary index ap, the cosmic rays intensity and of storm-time variations H are plotted. The latter allows to distinguish three phases of storm-time variations in 1958: initial, major and recovery phase. Author

N67-33683# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE CRUST AND THE UPPER MANTLE OF THE CONTINENTS

V. V. Beloussov 1966 124 p refs In RUSSIAN; ENGLISH summary CFSTI: HC $3.00/MF $0.65

Geologic, geophysical, and geochemical data were evaluated in an examination of the chief peculiarities of the structure and development of the continental tectonosphere (Earth crust and upper mantle). International geophysical research developments are reported on the approximate calculations of energy involved in geologic and geophysical processes. The general process determining the development of the tectonosphere supported by evidence, is shown to be the differentiation of matter in the upper mantle caused by its partial melting. This partial melting, accompanied by the accumulation of drops of liquid basalt, takes place in the seismic waveguide. The basalt drops accumulate into large masses (asthenoliths). By cooling the asthenoliths transfer their heat to the crust where they cause processes of degranitization below the gneissification and granitization at higher levels. These processes are characteristic of geosynclines. The wave oscillatory (epeirogenic) movements in geosynclines and the tectonic evolution from geosyncline to paragеosyncline, and to the young platform structure are other areas studied. Tectonic activization, periodicity of tectogenesis, and general oscillations of continents are included in the discussion. R.U.

N67-33684# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

METAMORPHISM AND DEEP STRUCTURE OF THE NORITE–DIORITE (GRANULITIC) SERIES OF RUSSIAN LAPLAND

V. V. Zhdanov 1966 65 p refs In RUSSIAN; ENGLISH summary CFSTI: HC $3.00/MF $0.65

In a study of structural metamorphism in the Russian Lapland, geological profiles studies determined that the degree of granitization of rocks decreases with depth, and this is confirmed by data on the general sinking of the massive westward. On the periphery of the norite–diorite massive, the zone of basification of rocks is developed; these resemble in composition amphibolite gabbro, anorthosite with stratification of eclogite-like rocks and amphibolite. The formation of the gabbro–anorthosite zone is associated with the introduction of calcium iron and alumina from the granitization zone of the central part of the massive. Recent geologic-geophysical studies indicate that the norite–diorite massive is a large block of the earth's crust bounded by a system of deep faults and rising 5 to 6 km above the surrounding structures. The norites and hypersthenic diorites are the initial rocks of the basaltic layer partly changed in the new physico–chemical conditions of the upper part of the crust. Metamorphic differentiation studies and the processes of metasomatosis in the rocks of the dislocated block of the basaltic layer indicate their close relationship with various dynamic conditions of the state of matter appearing concurrent with the movement of the whole block and which would suggest that the inhomogeneity of the basaltic layer, usually observed during seismic studies, is connected primarily with metamorphic–metasomatic zonality. R.U.

N67-33686# Hamburg Univ. (West Germany).

EARTH EXPANSION GENERAL RELATIVITY PROBLEMS OF ABSTRACT ALGEBRA Final Report

Pascual Jordan 1967 61 p refs

(Contract AF 61(052)-567)

(ARL-67-0122; (AD-653981) CFSTI: HC $3.00/MF $0.65

Contents: Comparison with Wegeners Ideas; Paleoclimatology in Wegeners and in the New Theory; Ramsey's Hypothesis about the Interior of the Earth; Quantitative Values about Dirac's Hypothesis; Field Equations and Equations of Motion in General Relativity; Problems of Abstract Algebra. TAB

N67-33732*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN OZONE MEASUREMENT IN THE STRATOSPHERE AND LOWER MESOSPHERE BY MEANS OF A ROCKET SONDE

Ernest Hilsenrath Mar. 1967 19 p refs

(NASA-TM-X-55732; X-622-67-115) CSCL 04A

A technique for the measurement of ozone content in the stratosphere and lower mesosphere by means of a rocket sonde has been developed. The measurement is accomplished by an in-situ determination of the ozone mixing ratio as a function of altitude by means of an ozone sensor utilizing a chemiluminescent detector. The atmosphere is sampled by a self pumping method as the sonde is dropped from apogee via a specially designed high altitude parachute. The ozone detector is not absolute and therefore, must be calibrated before the flight. The first ozone sonde was launched on a Nike Cajun Rocket. The ozone profile was not measured during this flight because of the failure of the parachute to deploy. However, a brief measurement of ozone mixing ratio just over apogee was accomplished. The measurement yielded .80 microgrems/gram and 1.9 microgram/gram at 59 km and 57 km respectively, where apogee was fixed at 60 km. The error in mixing ratio is 35% and because of a tracking failure the error in altitude is ±5 km. Author

N67-33742 Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
GEOPHYSICAL INVESTIGATIONS, COLLECTION I [GEOFIZICHESKIYE ISSLEDOVANIYA, SBORNIK I]
A. I. Zaborovskiy, ed. Jan. 1967 59 p refs Transl. into ENGLISH from Geofizicheskie Issled. (Moscow), no. 1, 1964 p 130–161, 196–222
(ACIC-TC-1147; TT-67-60995; AD-646881)

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1. ON THE QUESTION OF COMPILING CHARTS OF LOCAL TERRAIN CORRECTIONS DURING A GRAVIMETRIC SURVEY V. I. Aronov p 1–5 refs (See N67-33743 19-13)

2. INTERPRETATIONAL POSSIBILITIES OF THE METHOD OF STATISTICAL CORRELATION OF GRAVIMETRIC AND SEISMIC DATA B. A. Bryusov p 6–23 refs (See N67-33744 19-13)

3. ON THE NATURE OF LOCAL GRAVITY ANOMALIES IN THE NORTHERN CIS-CAUCASUS B. A. Bryusov and G. M. Geysherik p 24–31 refs (See N67-33745 19-13)

4. SOME QUESTIONS OF THE DEEP STRUCTURE OF THE EARTH'S CRUST IN THE CIS-CAUSCASUS R. F. Volodarskiy and B. L. Livovarov p 32–40 refs (See N67-33746 19-13)

5. METHODS AND RESULTS OF STUDYING THE EARTH-CRUST DENSITY CROSS SECTION IN THE SOUTHERN VERKHOYANSK-CHUKOT FOLDED REGION p 41–56 refs (See N67-33747 19-13)

N67-33743 Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ON THE QUESTION OF COMPILING CHARTS OF LOCAL TERRAIN CORRECTIONS DURING A GRAVIMETRIC SURVEY
V. I. Aronov *In its* Geophys. Invest., Collection I Jan. 1967 p 1–5 refs (See N67-33742 19-13)

Introduction of corrections for errors of height interpolation is shown to result in corrections for local terrain, even in a mountainous region, with a relatively small initial radius of interpolation. In comparatively level terrain, the interpolation is made with extremely high accuracy; and the overall method outlined is adaptable to both conventional and automated computation. An expression is given for solving for the direct problem of gravity surveying, from which the interpolation method is evolved. Data are included for corrections made in the Carpathian mountains.
M.W.R.

N67-33744 Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
INTERPRETATIONAL POSSIBILITIES OF THE METHOD OF STATISTICAL CORRELATION OF GRAVIMETRIC AND SEISMIC DATA
B. A. Bryusov *In its* Geophys. Invest., Collection I Jan. 1967 p 6–23 refs (See N67-33742 19-13)

Formulations based on a statistical correlation of gravimetric and seismic data are discussed, and its use under real geological conditions is illustrated by an examination of a diagram of the Paleozoic basement's structure. Comparison of this basement surface per borehole data revealed good correspondence only in the northern part of the territory considered; to the south, isohypse numbers and the basement depths were 500 to 600 m apart. It is proposed that the present diagram method reflects the structural peculiarities of the folded basement more accurately than extrapolations based on a few regularities of facies.
M.W.R.

N67-33745 Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ON THE NATURE OF LOCAL GRAVITY ANOMALIES IN THE NORTHERN CIS-CAUCASUS
B. A. Bryusov and G. M. Geysherik *In its* Geophys. Invest., Collection I Jan. 1967 p 24–31 refs (See N67-33742 19-13)

Local gravity anomalies of the northeast cis-Caucasus appear to be connected with either the forms and composition of the crystalline basement or the presence of petrographic nonuniformities in the body of the folded Paleozoic complex. This interpretation does not exclude a relationship with anomalies in the sedimentary layer, which also traces its forms to these more ancient formations. The tectonic concept presented is based on 13 profiles which cross the strongest local anomalies and zones of high gravity gradients; and it was assumed that anomalies represented by a gravity minimum were caused by a depression, while those represented by a maximum were caused by a protuberance. Both types of gravity extremums were considered to result from the disturbing action of two terraces lying opposite each other.
M.W.R.

N67-33746 Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
SOME QUESTIONS OF THE DEEP STRUCTURE OF THE EARTH'S CRUST IN THE CIS-CAUCASUS
R. F. Volodarskiy and B. L. Livovarov *In its* Geophys. Invest., Collection I Jan. 1967 p 32–40 refs (See N67-33742 19-13)

The peculiarities of the deep crustal structure bear a significant influence on the gravity field in the cis-Caucasus area; with increased crustal thickness related to negative gravity anomalies and districts where the Moho structure bulges upward related to positive anomalies. The cis-Caucasus formation is closely connected to that of the Caucasian folded structure; and there appears to be a close relationship between the deep crustal structure and upper geological layers. Negative gravity anomalies are also associated with increased thickness in granite layer; and this is associated with the mobility of the earth's crust, primarily with intense folding. The stable crustal areas in the Russian platform, on the other hand, are characterized by both lesser thickness in the granite layer and positive gravity anomalies.
M.W.R.

N67-33747 Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
METHODS AND RESULTS OF STUDYING THE EARTH-CRUST DENSITY CROSS SECTION IN THE SOUTHERN VERKHOYANSK–CHUKOT FOLDED REGION
Yu. Ya. Veshchilov *In its* Geophys. Invest., Collection I Jan. 1967 p 41–56 refs (See N67-33742 19-13)

Rock samples of good soundness from outcrops, mine spoil heaps, and mine shafts were selected for study of the density cross section of the earth's crust in the southern Verkhoyansk–Chukot folded region. Three methods were employed: (1) direct determination of rock densities followed by statistical processing of data, (2) measurements of rock densities in their natural bedding via gravimetric observations in the shafts, and (3) density determinations by interpretation of geophysical data. Results for the uppermost layers of the crust were obtained by all three methods, but information on deep crust cross sections (granite layer, basalt layer, and subcrustal substance) was by the third method only. Mean density values are tabulated for sedimentary rock of Mesozoic and Persian origin and for eruptive rocks; and for 12 deep earth complexes determined by geophysical observations.
M.W.R.

N67-33748 Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
CALIBRATION OF GRAVIMETERS WITH HORIZONTAL TORSION FILAMENT BY TILT METHOD
V. A. Romaniuk and R. B. Rukavishnikov 1966 127 p refs In RUSSIAN; ENGLISH summary CFSTI: HC$3.00/MF$0.65

Sensitivity, and calibration by the tilt method for several types of gravimeters are discussed. A general equation is derived on an elastic system with horizontal torsion filament and allowance for errors of the elastic system installation relative to the body of the gravimeter. Gravimeters of the following types are considered:

Worden gravimeter, Norgard, gravimeter with one elastic system, gravimeter with two elastic systems, and Graf-type gravimeter. Several theoretical scale models were used in a study of possible errors caused by the change of a precise equation of the scale of the instrument by an approximated one in the form of a polynom of the first and second order. The tilt method is illustrated with the aid of a plate as the mobile part. R.Ll.

N67-33757* Volt Technical Corp., Washington, D. C.
SIMULTANEOUS OCCURRENCE AT CONJUGATE POINTS OF CLASS PC-1 MICROPULSATION BURSTS [ODNOVREMENNOYE VOZNIKNOVENIYE V SOPRYAZHENNYKH TOCHKAKH VSPLESKOV MIKROPUL'SATSIY KLASSA PC-1]
M. Gokhberg, R. Zhendren, S. Lakurli, V. Troitskaya, and R. Shchapetnov 15 Aug. 1967 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 174, no. 4, 1967 p 828–829
(Contract NAS5-12487)
(NASA-CR-87184; ST-GM-10639) CSCL 04A

New data are presented on the characteristic properties of oscillation intervals decreasing by period and representing the conjunction of Pc-1 and Pi-1 types of oscillations. It is assumed that in this case a simultaneous excitation of two hydromagnetic waves of different mode takes place, these propagating in opposite directions. This is linked to the various events taking place in the upper atmosphere of the Earth. Author

N67-33831 Joint Publications Research Service, Washington, D. C.
ORIGIN AND DYNAMICS OF OCEAN WAVES STUDIED
A. Ye. Zubkov 12 Jun. 1967 17 p Transl. into ENGLISH from Priroda (Moscow), no. 3, Mar. 1967 p 36–46
(JPRS-41-349; TT-67-31983) CFSTI: $3.00

The formation of ocean waves from wind cyclones, and their propagation over the ocean surface, are discussed. The energy, shape, periodicity, interference patterns, and impact force of ocean waves are also discussed. L.S.

N67-33851# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
PRELIMINARY RESULTS OF ELECTRIC FIELD MEASUREMENTS IN THE AURORAL ZONE
H. Foeppl, G. Haerendel, L. Haser, R. Luest, F. Melzner et al 20 Jul. 1967 15 p refs CFSTI: HC $3.00/MF $0.65

In April 1967 five Nike–Apache rockets were launched from Kiruna (Sweden) carrying barium release and electron density experiments. The component of the electric field transverse to the magnetic lines of force is derived from the motion of the ion clouds. The electron density measurements provide ionospheric conductivities. The magnitude of the electric fields varied between 2 and 20 V/km. Their directions were northwestward for evening conditions and southwestward for morning conditions. The magnetic perturbations on the ground that would result from ionospheric currents derived on the basis of the measured fields and conductivities closely resemble the actual ground magnetometer data. The electric fields vary appreciably with space and time, they can even reverse their directions over distances of the order of 60 km. Author (ESRO)

N67-33867*# Volt Technical Corp., Washington, D. C.
FEATURES OF PLANETARY DISTRIBUTION OF OZONE ACCORDING TO OBSERVATION FROM AES
V. A. Iozenas, V. A. Krasnopol'skiy, A. P. Kuznetsov, and A. I. Lebedinskiy 14 Aug. 1967 9 p refs Transl. into ENGLISH of a paper presented at the 10th Plenary Meeting of COSPAR, London, 24–29 Jul. 1967
(Contract NAS5-12487)
(NASA-CR-87182; ST-AM-GM-10636) CSCL 04A

Ultraviolet spectra of solar radiation reflected from the Earth's atmosphere, were measured from two artificial earth satellites and data obtained were used to study the planetary distribution of ozone. The latter is not uniform and a number of local extremes of 2 to 3000 km dimensions were observed. Some of these extremes were regularly observed for three days. The mean planetary distribution of ozone showed a latitude dependence corresponding to the decrease in ozone content in the upper atmosphere in approaching high latitudes. The latitude dependence was different at various altitudes. A 20 to 30 percent decrease in ozone concentration was observed within a region of 10000 km. This effect was somewhat weakened within a day, and the middle part of the region of decreased concentration shifted westward by about 2000 km. On the third day, the ozone depression was insignificant. The appearance of this depression coincided with the sudden commencement of the magnetic storm of 17 April 1965. Author

N67-33886*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MODEL EQUATORIAL ELECTROJET
Masahisa Sugiura and Joseph C. Cain Nov. 1965 24 p refs
(NASA-TM-X-55404; X-612-65-482) CFSTI: HC $3.00/MF $0.65
CSCL 04A

The cross-sectional profile of the equatorial electrojet is determined for various longitudes along the dip equator, using a set of 48 Gauss coefficients for the earth's magnetic field. The electrojet profile is found to vary appreciably with longitude due to the asymmetry of the magnetic field. To demonstrate the longitudinal variation of the electrojet the profiles for longitudes 80°E (for India) and 280°E (for Peru) are shown. The maximum current density in the electrojet for the latter longitude is found to be much greater than that for the former longitude. Also, the width of the electrojet is greater at 280°E than at 80°E. The magnetic field produced by the electrojet is computed for various longitudes along the dip equator and also for the locations of six magnetic observatories near the dip equator. The theoretically expected field changes are qualitatively in agreement with the observed values for these observatories. The average electron drift velocity in the electrojet is estimated; over Peru this velocity reaches a few km/sec during a sunspot maximum period at the height of the peak of the electrojet. This value is considerably higher than earlier estimates and is well above the critical electron velocity, i.e., the ion thermal velocity, above which the two-stream instability can occur. Author

N67-33946# University Coll., London (England).
MEASUREMENT OF ELECTRIC FIELDS IN THE IONOSPHERE AND MAGNETOSPHERE
R. L. F. Boyd Paris, ESRO, May 1965 19 p refs Presented at the ESRO Colloq. on Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes, Stockholm, 16–18 Nov. 1965
(ESRO-SN-27) CFSTI: HC $3.00/MF $0.65

Electric fields in the ionosphere are not very well known because they are difficult to measure. The difficulties arise from: (a) the great difference in intensity between electric fields parallel to the geomagnetic field and those which are perpendicular to it; and (b) the difficulty in defining a suitable reference frame. The relative velocity of the spacecraft with respect to the Earth introduces additional difficulties, especially as regards the measurements of $E_{//}$ for which a very accurate determination of the spacecraft attitude is required. Direct measurements of the electric field consist essentially of measuring the potential difference between two points of the plasma through which the spacecraft is moving. This is achieved by the use of space potential probes carried on the ends of booms with an appropriate geometrical configuration. This method is preferable to one using electrodes at floating potential since it is less sensitive to the influence of positive ion and photo-emission fluxes. The thermionic emission method is briefly

mentioned. An alternative method of measuring electric fields is based on the determination of the drift velocity of ions, the knowledge of which can be yielded by chemical release methods or by Druyvestein analysis. Author (ESRO)

N67-33962* Northwestern Univ., Evanston, Ill.
A PROGRAM FOR THE RAPID SCREENING OF MULTIVARIATE DATA FROM THE EARTH SCIENCES AND REMOTE SENSING
Robert G. Garrett 31 Jul. 1967 52 p refs
(Grant NGR-14-007-027)
(NASA-CR-87281; Rept.-11) CSCL 08D

The Fortran IV computer program presented is for the computation of a number of simple statistical parameters. The program will handle up to 20 variables measured on each of 500 cases and computes with or without an optional logarithmic transformation. Means, variances, standard deviations, skewnesses and kurtoses are computed together with the plotting of histograms. Options are available for plotting the histograms in three different manners, carrying out a chi square test for normality, computing a product moment correlation matrix, from which the eigenvalues are extracted, and a matrix of Students t values for the correlation coefficients. A number of operations involving standard normal deviates, including the punching of a new data deck and plotting scattergrams of all pairs of variables, can also be carried out. Chemical data obtained from samples of gruss collected on a grid in the NASA Sonora Pass Test Site, California are used to illustrate the use of the program. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-32702# Franklin Inst., Swathmore, Pa. Bartol Research Foundation.
A GAMMA RAY DETECTING SYSTEM Final Report
D. M. Van Patter and P. F. Hinrichsen 26 May 1967 37 p refs
(Grant AF-AFOSR-1110-66)
(AFOSR-67-1215; AD-653217) CFSTI: HC $3.00/MF $0.65

A versatile gamma-ray detecting system has been brought into operation. It is a coincidence-anticoincidence Ge(Li)-NaI(Tl) spectrometer, mounted on a turntable to permit the measurements of angular distributions of gamma radiations, produced by nuclear reactions involving charged particles. It consists of a central 20 cc Ge(Li) detector surrounded by a large NaI(Tl) annulus which is split into two optically-insulated halves. The method of processing events allows four different spectra to be stored simultaneously under identical gain conditions. Initial experiments using this system are outlined, as well as possible future uses and developments. For purposes of comparison, other new systems are described. Author (TAB)

N67-32740*# National Bureau of Standards, Boulder, Colo.
HYDROSTATIC PRESSURE TRANSDUCERS OF CARBON AND YTTERBIUM Final Report
J. W. Dean and R. J. Richards 1 Mar. 1967 28 p refs
(NASA Order R-45)
(NASA-CR-87161; NBS-9285) CFSTI: HC $3.00/MF $0.65
CSCL 14B

This report describes measurements of the hydrostatic pressure coefficients of electrical resistivity for carbon and ytterbium wire samples near 20°K, 76°K, and 300°K. Pressure coefficients ranging from -2.16×10^{-4} cm^2/kg to -1.79×10^{-4} cm^2/kg were found for carbon and -1.75×10^{-4} cm^2/kg to -0.69×10^{-4} cm^2/kg were found for ytterbium wire for pressures up to 70 kg/cm^2. An analysis is given of the available bridge output from these sensors, and a prototype static pressure transducer is described. The frequency response of the carbon sensor is also included. Pressure transducers with adequate electrical output for moderate pressures can be made from these elements, but temperature stabilization will be required. Author

N67-32755# American Meteorological Society, Boston, Mass.
SEPARATE MEASUREMENT OF UPWARD AND DOWNWARD RADIATION FLUXES [O RAZDEL'NOM IZMERENII VOSKHODIASHCHEGO I NISKHODIASHCHEGO POTOKOV RADIATSII]
L. Z. Prokh Bedford, Mass., AFCRL, Apr. 1967 12 p refs Transl. into ENGLISH from Tr. Ukr. Nauchno-issled. Gidrometeorol. Inst. (Kiev), no. 48, 1965 p 107–112
(Contract AF 19(628)-3880)
(T-R-565; TT-67-62074; AD-653170) CFSTI: HC $3.00/MF $0.65

An instrument (double pyrgeometer) designed for separate measurement of upward and downward radiation fluxes is described. The radiation receivers are standard Yanishevsky balancemeters exposed to forced air. Author (TAB)

N67-32835# Ballistic Research Labs., Aberdeen Proving Ground, Md.
EVALUATION OF NEW SELF-RECORDING AIR BLAST INSTRUMENTATION: PROJECT 1.3b OPERATION SNOWBALL
Daniel P. LeFevre Jan. 1967 97 refs Supported by DASA
(BRL-MR-1815; AD-651041)

CONTENTS:
1. APPENDIX: PROTOTYPE, SELF RECORDING INSTRUMENTATION TEST OPERATION SNOWBALL H. S. Wells p 45–98 refs (See N67-32836 19-14)

N67-32836# Ballistic Research Labs., Aberdeen Proving Ground, Md.
APPENDIX: PROTOTYPE, SELF-RECORDING INSTRUMENTATION TESTS OPERATION SNOWBALL Final Report
H. S. Wells *In* Ballistics Res. Labs., Evaluation of New Self-Recording Air Blast Instrumentation Jan. 1967 p 45–98 refs (See N67-32835)

Field test data and experience useful in the design and development of self-recording blast instrumentation were obtained. Instruments were manufactured in accordance with in-progress design studies, used in the Operation Snowball field test, and finally tested and evaluated in the laboratory. The report includes descriptions of the self-recording instruments, test information, and recommendations for improvements. Author

N67-32885# Harry Diamond Labs., Washington, D. C.
AN UP-DOWN COUNTER FOR USE WITH SHOCK-TUBE INSTRUMENTATION
Gordon D. North Mar. 1967 22 p ref
(HDL-TM-67-5; AD-652876) CFSTI: HC $3.00/MF $0.65

An up-down counter was designed and built to provide precise synchronization of instrumentation used with the HDL pressure-driven shock tube. The counter is intended to trigger instruments measuring phenomena associated with the arrival of a shock wave. The counter described demonstrated proper operation over a range of 75 to 145 microseconds, repeatable to less than plus or minus 1 microsecond. The report includes a detailed description of the design and techniques employed in this application. Author (TAB)

N67-32860# HRB-Singer, Inc., State College Pa.
SYSTEMS THEORY AND THE ANALYSIS OF PHOTO-OPTICAL PROCESSES
M. P. Dutko, E. T. Nelson, and G. A. Markel Apr. 1967 28 p refs
(Contract Nonr-3818(00))
(Rept.-352; Rept.-352.16-R-4; AD-653110) CFSTI: HC $3.00/MF $0.65

Some criteria and techniques currently used for the evaluation and analysis of photo-optical systems are discussed. This includes a discussion of resolution and sharpness, photographic spread functions, and modulation transfer functions. A critical appraisal is made of appealing analogies between electronic systems and optical systems, with emphasis placed on analytical techniques that would be applicable to more than one component of a photographic system. Some attention is given to the advantages and limitations of using analogies from non-linear systems theory in this context, and existing chemical theory also is taken into consideration. It is observed, in conclusion, that a considerable amount of further research would be necessary in order to tie these several theories together in any useful way. Author (TAB)

N67-32868# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE BENNETT TYPE RADIO-FREQUENCY MASS SPECTROMETER
Chang Zeng-tsu, Chang Shao-chiang et al 29 Jan. 1967 31 p refs Transl. into ENGLISH from Pai-ching Ta Hsueh Hsueh Pao—Tzu Jan K'O Hsueh (Peking), v. 10, no. 2, 1964 p 169–180
(FTD-HT-66-690; TT-67-62009; AD-652462) CFSTI: HC $3.00/MF $0.65

Authors conducted experiments to study the static characteristics of a Bennett radio-frequency (RF) mass spectrometer. Bennett RF mass spectrometer is used to determine individual constituent contents in gaseous mixtures. The gaseous mixture is ionized by electron emission. The vacuum system which is capable of creating a vacuum of 0.000001 mm Gh for the mass spectrometer consists of a mechanical pump, an oil diffusion pump, a cryogenic arrester, a gallium-sealed ultrahigh vacuum switch, a cold-cathode titanium pump, a JIM-2 (LM-2) ionization vacuum gage, a B-A ionization gage, and a RF mass spectrometer tube with one end sealed. The electronic circuit in the mass spectrometer consists of an ion source, a low ionization current measuring circuit, an ion-accelerating sweep power supply unit, a high-frequency power supply unit, and a regulated power supply unit. The sawtooth generator in the ion-accelerating sweep power supply unit has an output sweep voltage of 50-250 v and a sweep frequency of 7-12 cps. Charging and discharging of the sawtooth generator is controlled by a thyratron. The high-frequency power supply unit is a fixed frequency oscillator having an operating frequency of 5 and 2 mc. A mass spectrogram of the residual gases left behind by the cold-cathode titanium pump can also be produced. Observations showed that secondary peaks appear on the oscillogram at an extremely high bias voltage or an extremely low damping voltage. A low-noise a.c. amplifier or a d.c. amplifier is used to measure the spectral lines of gases. The measuring accuracy of the oscilloscope can be improved if used in conjunction with a d.c. amplifier. Author (TAB)

N67-32873# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
RESULTS OF TESTS INVOLVING HEMISPHERICAL WIND SCREENS IN THE REDUCTION OF WIND NOISE
A. H. Breeland and R. S. Bonner Apr. 1967 42 p refs
(ECOM-5119; AD-653005) CFSTI: HC $3.00/MF $0.65

Hemispherical wind screens, covered with screen mesh and acoustic cloth, are of considerable value in reducing wind noise associated with infrasonic monitoring devices and improving the signal-to-noise ratio as shown in field and wind tunnel tests. The amplitude of the wind noise below sixteen (16) cps was significantly reduced and noise components at higher frequencies were effectively eliminated. Comparison tests showed that wind screens of three feet in diameter are more effective for noise reduction than the method used in the SOTIM (sonic observation of the trajectory and impact of missiles) system. Author (TAB)

N67-32971# Texas Univ., Austin. Defense Research Lab.
PRELIMINARY TOWED VEHICLE LOCATION TESTS ON THE HYDROFOIL BADDECK
R. L. Sullivan and C. C. Thomas 3 Apr. 1967 22 p
(Contract NObsr-93126)
(DRL-TM-3; AD-652612) CFSTI: HC $3.00/MF $0.65

Preliminary tests were made with DRLs Towed Vehicle Locator (TOVLOC) on the Canadian hydrofoil HMCS BADDECK 13-17 December 1966 near Halifax, Nova Scotia, to determine how much the performance of TOVLOC is degraded by the acoustic noise of the hydrofoil. The tests showed that TOVLOC can be used to track the BADDECKs towed vehicle at speeds up to 15 kt, and suggested that modifications to TOVLOC may permit towed vehicle location at high towing speeds. Author (TAB)

N67-33004# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STEREOMETROGRAPH [STEROMETROGRAF]
N. A. Tumar and T. P. Budylova 23 Jan. 1967 22 p ref Transl. into ENGLISH from Geod. i Kartografiya (Moscow), no. 10, 1966 p 51–59
(FTD-HT-66-390; TT-67-62008; AD-652461) CFSTI: HC $3.00/MF $0.65

The national firm of Karl Zeiss Jena is now mass-producing the Stereometrograph, a general purpose stereophotogrammetric instrument of first-order accuracy. The instrument is designed for compiling the relief and planimetric detail for topographic maps from 18 x 18-cm or 23 x 23-cm vertical aerial photographs with a focal length of 98-215 mm. The stereometrograph automatically registers the coordinates of model points, converts them into a geodetic coordinate system, calculates areas, and determines the corrections for elements of reciprocal orientation in the aerial photographs and for elements of exterior orientation in the stereo-model. The basic specifications of the instrument are listed, and its operation is described in detail using schematic diagrams. TAB

N67-33006# Danish Defence Research Board, Copenhagen.
DIRECTIONAL CHARACTERISTICS AND NEUTRON SENSITIVITY OF IONIZATION-CHAMBER DOSIMETERS [RETNINGSKARAKTERISTIK OG NEUTRONFOELSOMHED FOR DOSIMETRE MED IONISERINGSKAMMER]
Gunnar Johansen Aug. 1966 36 p refs In DANISH; ENGLISH summary
(NP-16701)

A project aimed at the development of a low-cost pocket dosimeter of the ionization-chamber type has been concluded. The dosimeter is indirectly readable. It can be stored in charged condition ready for use for several years. The directional sensitivity of the dosimeter to X-rays is investigated. The voltage drop varies ±19% for the aluminum type and ±17% for the Perspex type. A study is made of the neutron sensitivity of the dosimeter, defined by V per rem of neutron radiation/V per rem of gamma radiation. It is 4–6% for the aluminum type and 6.5–19% for Perspex type. As the neutron sensitivity is not equal to 1, the dosimeter cannot measure the sum of the neutron and gamma doses. In a mixed radiation field it measures the gamma dose with an uncertainty of 20% in most of the situations to which the civilian population is exposed. By using two dosimeters with different neutron sensitivity the neutron as well as the gamma dose can be measured. It is shown that the neutron dose is often so large that it should be measured. Author (NSA)

N67-33023# HRB-Singer, Inc., State College, Pa.
A DIGITAL APPROACH TO PHOTOGRAPHIC IMAGE QUALITY EVALUATION
Gene A. Markel and David J. Panzl May 1967 45 p refs
(Contract Nonr-3818(00))
(HRB-352:16-R-5; AD-653084) CFSTI: HC $3.00/MF $0.65

The report describes a research program concerned with the investigation of digital techniques for image quality evaluation. The quality of an image here is taken to mean its interpretability. A sample of reconnaissance imagery was digitized and then analyzed by digital computer to generate measurements of certain physical characteristics of each picture in the sample. A clustering technique was used to determine decision spaces based upon these measurements. The quality of any new test image then would be determined by assigning it to the quality category associated with the cluster having the nearest center of mass. The ideas discussed appear to have some potential value for further investigation.
Author (TAB)

N67-33025* California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
A MAGNETOMETER EXPERIMENT FOR THE APPLICATIONS TECHNOLOGY SATELLITE Final Technical Report, 5 Feb. 1965–6 Dec. 1966
R. C. Snare 6 Dec. 1966 15 p
(Contract NAS5-9570)
(NASA-CR-86992) CSCL 22B

The experiment, consisting of two individual fluxgate magnetometers, offset field generators and spin demodulation circuits, measures the magnetic field environment of the Applications Technology Satellite (ATS) and resolves the field into two orthogonal components, one parallel and the one normal to the spacecraft spin axis. The purpose of the experiment is to provide data for the study of the structure and variations of the earth's magnetic field and to provide magnetic field data for correlation with energetic particle and plasma experiments also on the ATS spacecraft.
Author

N67-33114 Joint Publications Research Service, Washington, D. C.
ELECTRONIC GRAPHING DEVICE FOR AUTOMATIC PROCESSING OF RECORDED METEOROLOGICAL INFORMATION
Yu. A. Kurpakov *In its* Collection and Interpretation of Meteorol. Data 28 Jun. 1967 p 22–34 refs (See N67-33111 19-04)

Automation problems concerning the processing of meteorological information recorded by means of automatic recording devices are examined. Two variations of a practical system of an electronic graphing device are given, which enable us to transform the results of a multichannel recording of meteorological values into graphs of changes of these values in time, on a prescribed scale along the axes of coordinates, efficiently and with an accuracy sufficient for practical purposes. Here the nonlinearity of calibration curves of pickups is corrected automatically.
Author

N67-33128# David Taylor Model Basin, Washington, D. C.
USE OF A LOW-FREQUENCY SPECTRUM ANALYZER
S. E. Lee and R. G. Tuckerman *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 67–71 refs (See N67-33122 19-32)

A low-frequency spectrum analyzer (LFSA) is described by which a selected signal may be analyzed simultaneously with the recording of other signals. The output of the analyzer is plotted in the form of a histogram for a frequency range from 3.50 to 23.67 cps. The LFSA has been modified for use on board ships, and its application in field studies is demonstrated.
Author

N67-33135*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRANSPORTATION ENVIRONMENTAL MEASUREMENT AND RECORDING SYSTEM
Frank J. Holley et al *In* NRL Shock and Vibration Bull., No. 36, Pt. 6, Feb. 1967 p 163–72 refs (See N67-33122 19-32) CSCL 14C

Details are given on a complete, unified system for the measurement of critical environmental parameters. It can operate continuously and unattended for over two weeks. Primary considerations in the design were economy, universal compatibility, maximum reliability, and practical weight, volume, and power consumption. Most of the electronics are molecular electronic devices which convert analog data from transducers into preanalyzed digital form for recording in IBM computer-compatible format on a cartridge incremental digital tape recorder. The recorded information includes the direction, magnitude, duration, and time occurrence of transient vibration or shock above predetermined threshold levels, as well as periodic measurements of quasi-static phenomena such as temperature and humidity. The system is based on using triaxial piezoresistive accelerometers with dc response to time duration measurements of 2 msec and three low-speed data channels for the periodic recording of quasi-static environmental data. Volume is slightly over 1 cu ft with a weight of approximately 35 lb. Over 100,000 complete sets of data can be recorded with the 300-ft tape recorder capacity.
Author

N67-33136# Army Natick Labs., Mass.
DEVELOPMENT OF VELOCITY SHOCK RECORDER FOR MEASUREMENT OF SHIPPING ENVIRONMENTS
Matthew A. Venetos *In* NRL Shock and Vibration Bull., No. 6, Pt. 6 Feb. 1967 p 173–181 ref (See N67-33122 19-32)

The primary purpose was to develop a velocity shock recorder capable of measuring and recording the shock environment, in terms of impact velocity or drop height, to which containers are subjected in shipment, handling, and storage. The performance requirements and electromechanical operation of a recorder developed during a preliminary investigation are discussed. In-house investigations to determine the duration of the shock inputs to be expected in typical container handling situations are described. This shock duration information was used to determine the required natural frequency of the velocity transducer. The problems encountered in the design and development of a suitable velocity transducer are described, as are efforts to develop a sliding rod magnet transducer satisfactory for the measurement of shock durations up to 30 msec, and of the response to those velocity components of angular impacts parallel to the sensitive axis of the transducer.
Author

N67-33137# National Bureau of Standards, Washington, D. C.
ABSOLUTE CALIBRATION OF VIBRATION GENERATORS WITH TIME-SHARING COMPUTER AS INTEGRAL PART OF SYSTEM
B. F. Payne *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 183–194 refs (See N67-33122 19-32)

A shaker calibration procedure is described, in which magnitude and phase lag measurements are made. Calibrations to 10 kHz are planned. A teletypewriter gives access to a central time-sharing computer which can accept commands and data from punched paper tape or from the keyboard. The data may be recorded from digital measuring instruments by a special coupling system. Data reduction is rapid and permits errors to be corrected quickly. The combined use of the computer and the digital data recording system cuts the calibration time to about one-fourth that required by previous methods. Monitoring the quality of motion of the shaker by the computer makes possible improved accuracy of the calibration process. Calibration of one of the improved shakers is described.
Author

N67-33139# Sandia Corp., Albuquerque, N. Mex.
DEVELOPMENT OF LOW-COST FORCE TRANSDUCER
James A. Ellison (Calif. Inst. of Tech., Pasadena) and Marlyn W. Stark *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 203–205 refs Sponsored by AEC (See N67-33122 19-32)

Summary information is presented on the properties of a low-cost force transducer constructed from a polarized ferroelectric ceramic (PFC) material. To eliminate the need for electrical isolation, two PFC disks are placed, one on top of the other, with their axes of polarization in opposite directions. A piece of copper between the two disks acts as a common lead, and the insulation prevents the bolt from grounding the inside edge of the transducer. In comparison to commerical types, the transducer is said to be about 6% of the cost, 7 to 40 times as sensitive, and comparable in frequency response, preload effect, temperature effects, stiffness, and aging. M.G.J.

N67-33140*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AUTOMATIC CALIBRATION AND ENVIRONMENTAL MEASUREMENT SYSTEM FOR LAUNCH PHASE SIMULATOR
Harry D. Cyphers and Frank J. Holley *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 207–214 refs (See N67-33122 19-32) CSCL 14B

The Launch Phase Simulator (LPS) facility will completely cover in a single exposure the launch environmental condition; i.e., it will incorporate the latest vibration, acoustic, and vacuum developments with the static (or steady-state) loads generated during launch. The data collection system was designed to permit both automatic calibration and operation from a master control panel. The control panel functions as a complete status display of all data collection subsystems. The system can be completely calibrated and checked in less than 15 min and produce a digital printout to indicate system status. The data collection facility is designed around a 98-channel constant bandwidth frequency multiplex recording system which uses accelerometer and bridge-type signal conditioners as inputs. Specific requirements are frequency response 0 to 10,000 Hz, signal-to-noise ratio of 45 db, and interchannel phase correlation of 5 degrees from 0 to 4,000 Hz. A unique feature of this complex system is the complete integration of the many specialized calibrators by several automatic calibrators, a digital voltmeter, a scanner, and a master control panel. Author

N67-33142# New Mexico Univ., Albuquerque. Eric H. Wang Civil Engineering Research Facility.
INVESTIGATION OF PULSE X-RAY TECHNIQUES FOR STUDY OF SHOCK-WAVE-INDUCED EFFECTS IN SOIL
Warren J. Baker and Frank J. Janza *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 225–240 refs (See N67-33122 19-32)

With the advances in flash X-ray systems, tests were conducted to determine the capabilities of the system to resolve density variations in soil, edge detail of the buried models, and the maximum soil sample that could be penetrated and still produce usable radiographs. In the multiple flash X-ray system used in a typical test arrangement, a series of eight 1-μ sec pulses with a pulse-to-pulse time separation of 1000 μsec is generated. As the pulse repetition frequency is lowered, the number of pulses per sequence increases. The advantages and disadvantages of the system are assessed, and radiographs and 35-mm photographs are presented to show the results of some 20 tests. It was concluded that soil is a severe X-ray scattering medium; however, indications are that this can be reduced to a tolerable level by masks, filters, and lead screens. Experiments with field-emission-type X-ray systems are considered promising. M.G.J.

N67-33183*# National Aeronautics and Space Administration, Washington, D. C.
A METHOD FOR THE SIMULTANEOUS DETERMINATION OF THE LEVEL CONSTANT AND PERIODIC SCREW ERRORS OF A LEVEL TRIER
A. S. Kharin *In its* Probl. of Astrometry Aug. 1967 p 102–106 refs (See N67-33184 19-30)

A method by which both the value of a division of a level, and the periodic errors of a level trier can be determined simultaneously is proposed. An example of the practical application of this method is given. Author

N67-33196*# National Aeronautics and Space Administration, Washington, D. C.
AUGMENTING THE SENSITIVITY OF UNSENSITIZED PLATES FOR UNDEREXPOSED AREAS
L. L. Novoborskaya *In its* Probl. of Astrometry Aug. 1967 p 125–132 refs (See N67-33184 19-30)

Augmentation of the sensitivity of Agfa Astro unsensitized plates for the case of faint images and short exposure (parts of a second) is considered. Treatment with mercury vapor first before, then after exposure proved effective. It produced an increase in sensitivity of $1^m.5$. The best results were obtained by means of short exposure of a plate to light both prior and subsequent to taking the photograph. Being very convenient in astronomical practice, this method is capable of giving a gain of $1^m.5$ to $1^m.8$. Author

N67-33197*# National Aeronautics and Space Administration, Washington, D. C.
PHOTOELECTRIC DEVICE FOR RECORDING OCCULTATIONS OF STARS BY THE MOON
V. G. Burachek *In its* Probl. of Astrometry Aug. 1967 p 133–137 refs (See N67-33184 19-30)

A device for photoelectric registration of occultations of stars by the moon was made at the Poltava Gravimetrical Observatory. The device was set on a reflector of 250 mm aperture and 2.5 focal length. The limiting magnitude available with this instrument under the best observational conditions is 6.5–7. The accuracy attainable with the device is 0.01 to 0.001. Author

N67-33229*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BALANCED FILTERS FOR THE ANALYSIS OF Al, Si, K, Ca, Fe, AND Ni
J. A. Dunne and N. L. Nickle 1 Aug. 1967 14 p refs (Contract NAS7-100)
(NASA-CR-87164; JPL-TR-32-1134) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The design of auxiliary instrumentation for the X-ray fluorescence analysis of the elements Al, Si, K, Ca, Fe, and Ni was the result of one phase of research in a program to develop an instrument for remote X-ray diffraction analysis of lunar and planetary surface materials. The performance of balanced filters as dispersive elements is being evaluated for comparison with that of the electronic dispersion (pulse height analysis) technique. Author

N67-33250# Bureau of Mines, Amarillo, Tex. Helium Research Center.
CORRECTION FOR NONUNIFORMITY OF THE BORE OF A CAPILLARY TUBE VISCOSIMETER
John E. Miller, R. A. Guereca, H. P. Richardson, and J. L. Gordon Jul. 1967 28 p refs
(BM-RI-6979)

Absolute viscosity values for gases usually are determined with a capillary tube viscosimeter. One of the correction factors applied to the experimental data is that for nonuniformity of the capillary bore. Analytic expressions of the nonuniformity correction for the following cases: ellipse, cone, sine wave, sawtooth wave, square wave, and the general case are reported. The methods

herein described are applied to estimate the nonuniformity of a section of stainless steel capillary tubing. Several other examples are given to illustrate the usefulness of the present results. Author

N67-33271*# Ohio Univ., Athens. Research Inst.
LEAK DETECTION TECHNIQUE IMPROVEMENT STUDY FOR SPACE VEHICLES Annual Report, 7 Apr. 1965–6 Jan. 1967
Jan. 1967 264 p refs
(Contract NAS8-11199)
(NASA-CR-87158; EER-7-6; AR-2-a) CSCL 14B

A second generation model of the halogen gradient detector using the dual-flow principle is described. After a study of the state-of-the-art in leak detection methods, accompanied by experimentation with locally-generated concepts, the hot anode platinum diode modified by the dual-flow principle meets the specifications dictated by the application to missile leak detection best of all competitive concepts. A theoretical and experimental study of the platinum diode is presented. The helium separation probe was designed, developed, and tested for use with the mass spectrometer. The superiority of a Teflon membrane over heated silica glass for the given specifications is demonstrated. Author

N67-33277# Atomic Weapons Research Establishment, Aldermaston (England).
SAFETY ATTACHMENTS FOR X-RAY DIFFRACTION APPARATUS
P. G. Hambling and C. F. Sampson Feb. 1967 16 p refs
(AWRE-O-102/66) CFSTI: HC $3.00/MF $0.65

Attachments are described for a Hilger 9 cm X-ray-powder diffraction camera type Y103, and for a Philips PW1010/1050 diffractometer, which enable them to be used in comformity with the relevant parts of the Code of Practice for the Protection of Persons Exposed to Ionizing Radiation in Research and Teaching. Author (NSA)

N67-33288# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STROBOSCOPIC SECONDARY-EMISSION ELECTRON MICROSCOPE
G. V. Spival and V. G. Dyukov 31 Jan. 1967 17 p refs
Transl. into ENGLISH from Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 30, no. 5, 1966 p 742–748
(FTD-H-66-757; AD-649410) CFSTI: HC $3.00/MF $0.65

The purpose of a stroboscopic or gating electron microscope is to observe the successive quasi-instantaneous stages of dynamic processes; if the frequency of the investigated process is synchronized with the gating there will be obtained stationary images of the surface structure regardless of the frequency characteristics of the screen. In the case of an emission system with a three-electrode objective a stroboscopic regime can be realized in different ways: supply of the microscope with high-voltage pulses, modulation of the potential on the focusing electrode, or deflection of the beam by means of appropriate deflecting plates. In the instrument employed in the present work pulse modulation was employed. A block diagram of the microscope and associated electronic equipment is shown in the figure. Some of the parameters of the equipment and particularly of the ion source used for inducing the secondary emission are described in the paper. Author (TAB)

N67-33348# Army Electronics Labs., Fort Monmouth, N. J.
ANGULAR EFFECTS IN A MILLIMETER WAVE SEMICONDUCTOR INTERFEROMETER
Harold Jacobs, Edward Horn, Ronald Hofer, and George Morris Mar. 1967 67 p refs
(ECOM-2616; AD-653648) CFSTI: HC $3.00/MF $0.65

In a recent investigation, it was shown that electromagnetic radiation incident upon a layered system could give interferometric effects which result in zero reflection. It was shown that for millimeter waves falling upon a system composed of air as the transmitting medium, semiconductor, air, and metal reflector, critical parameters of conductivity, thickness and dielectric constant will give the desired results. Furthermore, by modulating the conductivity of the semiconductor, the reflection coefficient of the system could be varied. In this report, we consider the effects of angular incidence upon the interferometric system. It is concluded that the reflection coefficient is relatively insensitive to angle, and that in the application to the millimeter wave imaging system previously proposed, the optimum condition will be for planar construction of the multilayered device. Author (TAB)

N67-33417# California Univ., Livermore. Lawrence Radiation Lab.
APPLICATIONS AND OPTIMIZATION OF THE LITHIUM-DRIFTED GERMANIUM DETECTOR SYSTEM
David C. Camp 1 Mar. 1967 102 p refs
(UCRL-50156) CFSTI: HC $3.00/MF $0.65

The concept of semiconductors and how the semiconductor materials silicon and germanium are used as radiation detectors are discussed. The various types of lithium-drifted germanium detectors that have evolved are also discussed. Some of the requirements necessary if the detector and the electronic components that comprise the total system are to give the best possible performance are presented. The lithium-drifted germanium detector as a gamma-ray spectrometer and the various ways in which these detectors are being used are described. The reduction of germanium detector data using computers is evaluated. Author (NSA)

N67-33508# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
WEIGHING HEAVY LOADS TO AN ACCURACY OF 0.001%
Clarence A. Pippin 2 May 1967 11 p
(Contract AT(29-1)-1106)
(RFP-839) CFSTI: HC $3.00/MF $0.65

A study was performed to determine the accuracy attainable using a load cell and a readout technique. The data were obtained on a 200 pound Toledo Precision Load Cell. Equally reliable data are to be expected for 50,000 pounds on larger models of the same type of transducer. Operating the system for one week in a constant ambient temperature and with regulated line voltage, a total deviation of 0.001% was noted. For percentages over 18% of full load the total variation of readings amounted to 0.004% of full load in an ambient temperature that was uncontrolled. Author (NSA)

N67-33517# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
STABILIZATION SYSTEMS OF SPECTROMETRIC CHANNELS: REVIEW OF PUBLISHED DATA [SISTEMY STABILIZATSII SPEKTROMETRICHESKIKH TRAKTOV. OBZOR PO OPUBLIKOVANNYM MATERIALAM]
M. N. Omel'yanenko 1967 26 p refs In RUSSIAN Submitted for publication
(JINR-P13-3225)

All the systems of spectrometric channel stabilization are classified, considered, and compared. Author (NSA)

N67-33563# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
DOSE DISTRIBUTION OF HIGH ACTIVITY ^{60}Co SOURCE THROUGH GLASS DOSIMETRY
A. Grisanti and P. Tori 10 Nov. 1966 17 p refs
(ISS-66/42)

The relative merits of methods suited for the dosimetry of large isotopic sources are discussed. The results of a calibration of a Gammabeam 650 source with glass dosimeter are presented.

The concluding remarks show not only the feasibility of the method but also the possibility of extending the use of the glass dosimeter to dose distribution determination of sources of therapeutic interest. Author (NSA)

N67-33560# TRW Systems, Redondo Beach, Calif.
EXPLORATORY DEVELOPMENT OF THE RADIOTRACER PROPELLANT GAUGE, PHASE II Final Report, Apr. 1965–Aug. 1966
B. Burns, R. W. Harman, R. J. Rusch, R. B. Spencer, and G. A. Siak Nov. 1966 146 p refs
(Contract AT(04-3)-539)
(TID-23666) CFSTI: HC $3.00/MF $0.65

The analytical and experimental evaluation of radiotracer propellant gauge compounds is described. Progress is reported on the following major efforts: (1) A radiotracer propellant gauge for a bladder expulsion system was fabricated and successfully tested. (2) analyses and tests were performed to evaluate ^{85}Kr interactions with bladder expulsion system propellants and materials. Experimental evaluations of ^{85}Kr diffusion through bladder materials and of ^{85}Kr solubility in liquid rocket propellants were accomplished in this task. (3) Several techniques were investigated for the application of radiotracer gauging techniques to bladderless expulsion systems. (4) Krypton injector assemblies were designed and fabricated. (5) Flight-type detector electronics packages were designed, procured, and tested. (6) Methods were investigated for protecting exposed gauge detectors from highly corrosive propellent vapors while still permitting transmission of beta radiation. Author (NSA)

N67-33730# Pennsylvania Univ., Philadelphia.
A FULLY AUTOMATIC HPD SYSTEM FOR SPARK CHAMBER PICTURES
Olin B. van Dyck 18 Jan. 1967 25 p refs Presented at the Intern. Conf. on Programming for Flying Spot Devices, Munich, 18–20 Jan. 1967
(Contract AT(30-1)-2171)
(NYO-2171-221; CONF-670105-5) CFSTI: HC $3.00/MF $0.65

A description is presented for a fully automatic HPD system for spark chamber pictures. The topics considered include the experiment analyzed, the University of Pennsylvania HPD, the analysis program, and the program performance. NSA

N67-33748# Israel Program for Scientific Translations, Ltd., Jerusalem.
HANDBOOK OF RECORDING INSTRUMENTS FOR IONIZING RADIATION
M. E. Egorov, A. F. Lazarev, N. L. Pervo, A. A. Timofeev, V. S. Zhernov, comp. et al 1967 468 p refs Transl. into ENGLISH of the book "Apparatura Dlya Registratsii i Issledovaniya Ioniziruyushchikh Izluchenii" Moscow, Atomizdat, 1965 Published for AEC and NSF
(AEC-TR-6709) CFSTI: HC $3.00/MF $0.65

This book describes mass-produced and experimental Soviet equipment devices, installations, photomultipliers, scintillators, Geiger-Mueller counters, ionization chambers, etc. It contains characteristics of devices used for personnel dosimetry, dose and dose rate measurements, monitoring the radioactive contamination of work surfaces and water, aerosol instruments, single-channel and multichannel pulse analyzers, etc. The handbook is intended for experimental physicists, health-physics personnel, engineers and scientists working with nuclear radiation sources, as well as people engaged in the development, use and repair of nucleonic equipment. Author

N67-33756# Aeroprojects, Inc., West Chester, Pa.
APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS Bimonthly Progress Report, 1 Dec. 1966–31 Jan. 1967
Feb. 1967 20 p refs
(Contract AT(30-1)-3622)
(NYO-3822-7; BMPR-32) CFSTI: HC $3.00/MF $0.65

Work on the incipient boiling detector was concentrated on investigations of scatter in recently–acquired cavitation data, and two sources of the scatter were identified. Improved thermal uniformity produced by mechanical agitation of the liquid was found to reduce scatter in data acquired for molten tin, indicating the value of agitation in a molten potassium system. Additional scatter was attributed to non-vaporous cavitation; functional control over scatter of this origin is believed exerted by normal operation of the incipient boiling detector at temperature ranges near the boiling point. Work on the ultrasonic flowmeter has concerned the development of pulse–shaping circuitry and the improvement of signal reception in the test apparatus. Author (NSA)

N67-33764# Naval Research Lab., Washington, D. C.
THE MARK IV ATMOSPHERE ANALYZER
F. S. Thomas *In its* The Present Status of Chem. Res. in Atmosphere Purification and Control of Nucl.-Powered Submarines 11 Jan. 1967 p 13–17 refs (See N67-33761 19-05)

Continued efforts to improve the Mark IV atmosphere analyzer which is the limited objective service equipment intended to provide a continuous determination of the concentrations of the principle components of the nuclear submarine atmosphere requiring surveillance and control; are reported. Considerable improvement in the production and test facilities for the preparation of Mark IV detectors and sources at the Beckman plant was made. Also, many minor changes in design and in production techniques were made all of which are intended to improve the life of these components and consistency between units. Despite reported improvements, service life of the acceptable components continues to be very short. The basic cause of service failures of detectors and services is attributed to leakage from the sealed spaces involved. Additional information on component behavior in service, along with the return of components that have failed in use or in storage, is recommended in order to permit a more effective coordination of efforts to improve these components. A test procedure was prepared for service certification of detectors and sources has been revised and amplified. Experimentally determined corrections to the technical manual relating to source resistance and hydrogen indication corrections have been listed. S.C.W.

N67-33765# Naval Research Lab., Washington, D. C.
THE NRL TOTAL HYDROCARBON ANALYZER
Walter D. Smith *In its* The Present Status of Chem. Res. in Atmosphere Purification and Control on Nucl.-Powered Submarines 11 Jan. 1967 p 18–22 refs (See N67-33761 19-05)

The development of an instrument called the total hydrocarbon analyzer for determining the total hydrocarbon concentration in the atmospheres of nuclear submarines is reported. Presented is a brief description of the instrumentation and its operations, and a discussion of its application to shipboard use. Briefly, the total hydrocarbon analyzer is a gas chromatographic system which employs a flame ionization detector. This detector is highly sensitive to hydrocarbons and, to a lesser degree, is sensitive to other organic substances. Several models of the analyzer have been designed and fabricated. These models have been used successfully on board several operating submarines. The analyzer has been shown to be versatile and adaptable to the study of shipboard problems, such as determination of the efficiency for removal of various organic contaminants by the main filter carbon beds and the CO/H_2 burners. In order to make shipboard use of the total hydrocarbon analyzer more practical, a scheme was devised for cleaning the ship's air so that it could be used as an air supply for the analyzer. A chromatogram of an air sample from the USS SCAMP is illustrated. Also included are tables containing comparative data which show some determinations of the total hydrocarbon contamination made aboard the SCAMP and determinations made by

the carbon sampling method. It is recommended that commercial units be procured for issue to each nuclear submarine as soon as certain minor modifications are made in the instrument and further trials at sea are made to improve its operational capability. S.C.W.

N67-33781# Argonne National Lab., Ill.
PROCEEDINGS OF THE AMU-ANL WORKSHOP ON HIGH-VOLTAGE ELECTRON MICROSCOPY
[1966] 242 p refs Workshop held in Argonne, Ill., 13–15 Jul. 1966; Sponsored by Assoc. Midwest Univ. and Argonne Natl. Lab.
(Contract W-31-109-ENG-38)
(ANL-7275; CONF-660646) CFSTI: HC $3.00/MF $0.65

Papers and workshop reports on high voltage, lens design, specimen facilities and recording, and structural problems are presented. For individual titles see N67-33781–N67-33824.

N67-33786# Illinois Univ., Chicago.
SUMMARY OF LENS SYSTEMS FOR HIGH-VOLTAGE ELECTRON MICROSCOPES
David Cohen *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 25–31 (See N67-33781 19-14)

A design is suggested for a high voltage reference lens, based on the conventional round lens with an iron shroud and copper coils, and for a 3 MeV electron microscope column. Total lens weight is 6 to 7 tons, total power consumption is about 12 kW, and the theoretical limiting resolution is about 1.5 Å. The design was extrapolated to 5 MeV. Quadrupole magnetic lens systems activities are discussed, and quadrupole magnet combinations are classified; each subgroup is further subdivided by the number of x and/or y crossovers. Relationships between lenses and other components are considered, and comparisons are drawn between the reference lens, a suggested superconducting lens, and a Russian quadruplet. A magnetic shield system is proposed to shield the electrons in a high voltage microscope. M.G.J.

N67-33787# Cambridge Univ. (England).
THE ROLES OF QUADRUPOLE LENSES AND QUADRUPOLE CORRECTORS IN HIGH-VOLTAGE MICROSCOPY
Peter W. Hawkes *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 32–37 (See N67-33781 19-14)

The properties of quadrupole lens combinations were studied with a view to using them in the high voltage microscope, either as complete lenses or as correctors for normal or superconducting round lenses. A rectangular model was used throughout the computations on the IBM 7094 program. Two reasons are given for introducing quadrupole systems to overcome the drawbacks of conventional round lenses: (1) Quadrupole lenses focus the beam directly, whereas the focusing property of round lenses is a differential effect. (2) Quadrupole lenses are probably the simplest type with which spherical aberration can be completely cancelled. The quadrupole combinations selected are analyzed, and details are given on the various systems proposed. Figures are included to support the proposition that there are quadrupole combinations which, even without the octupoles normally regarded as necessary when quadrupoles are used, can rival the image-forming qualities of round lenses. M.G.J.

N67-33788# Argonne National Lab., Ill.
SUPERCONDUCTING LENS STUDIES
Charles Laverick *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 38–48 (See N67-33781 19-14)

Several examples are given to demonstrate the feasibility of using superconducting lenses in practical electron microscopes. Problem areas are discussed which indicate that the superconducting lenses are not as good as commercially available conventional lenses and resolutions. Theoretical results of several studies are presented as a guide to desirable practical configurations. Typical field profiles and pole arrangements for conventional and superconducting lenses are depicted. Parameters for superconducting objective lenses are tabulated to show some calculated fields and field gradients for possible systems from 100 to 1000 kV, and for various estimated accelerating voltages and maximum fields. M.G.J.

N67-33789# Cambridge Univ. (England).
EXPERIENCES AT CAMBRIDGE IN OPERATING ELECTRON OPTICAL SYSTEMS IN VARIOUS ORIENTATIONS
William C. Nixon *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 49–50 refs (See N67-33781 19-14)

A simple, vertical electron optical bench, used in teaching electron optics, is described. For comparing the light microscope and the electron microscope, a tungsten filament acts as the light source for a test specimen grid which is viewed by a normal glass objective and a glass eyepiece on a ground glass plate in order to achieve the exact analogy with the electron optical system. The extension of this instrument into a more elaborate, commercially available system is also described, as are the types of scanning microscopes in operation. The relative advantages of vertical versus horizontal columns are assessed, with a strong preference for the vertical column indicated. M.G.J.

N67-33790# Chicago Univ., Ill.
ELECTRON MICROSCOPY WITH SUPERCONDUCTING LENSES
Humberto Fernandez-Moran *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 51–58 refs (See N67-33781 19-14)
(Grant NsG-441-63; Contracts AT(30-1)-2278; AT(11-1)-1344; Grants NIH GM-13243; NIH NB-04267)

Details are given on a comprehensive research program which is being conducted on different types of cryo-electron microscopes. Two approaches to the problem are discussed. The cryo-electron microscope optical system comprises a modified air-core liquid helium dewar in which different types of niobium–zirconium solenoid lenses operate at 4 to 32 kG without pole pieces. It also contains modified objective and objective–projector pole pieces, the objective pole pieces being of conventional design with focal lengths of 1.6 to 2.6 mm. The second major approach involves a superconducting objective lens in a specially designed liquid helium dewar. The lens may be used as an integral part of cryo-electron microscopes or may replace the objective lens in a modified commercial, high resolution electron microscope. It is made up of niobium–zirconium main and vernier coils of 32,580 ampere turns with superconducting stigmators, persistent current switches, and improved current-control devices. In the experiments, microstages maintained at 4.2°K were used for mounting specimens that could also be inserted within different types of pole pieces. Some representative illustrations of the electron micrographs obtained are included. M.G.J.

N67-33791# Armed Forces Inst. of Pathology, Washington, D. C.
DISCUSSION OF CROSS SECTIONS OF POSSIBLE CONTRAST MECHANISMS IN THE ELECTRON MICROSCOPE
Elmar H. Zeitler *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 62–70 refs (See N67-33781 19-14)

The problem of contrast mechanisms is examined in relation to three classes of cross sections: elastic processes (single elastic scattering, and plural–multiple scattering); inelastic processes with characteristic energy losses (single electron transition, and plasmon excitation); and inelastic processes with noncharacteristic energy

losses (K-shell ionization, and Bremsstrahlung). The inelastic cross sections are considered particularly interesting for scanning microscopy because the energy losses bring about a new dimension for characterizing the target composition. Mathematical expressions for the various cross sections are derived. It is shown that these can be written in a unified form which permits quick and rough comparison in terms of magnitude and general trends. M.G.J.

N67-33792# Argonne National Lab., Ill.
SPECIMEN FACILITIES FOR VERY-HIGH VOLTAGE MICROSCOPES
Raymond K. Hart *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 71–78 refs (See N67-33781 19-14)

The reasons for constructing very high voltage microscopes are discussed in relation to the bearing they have on the specimen facilities that should be provided. These are: (1) better theoretical resolution than is possible with conventional microscopes operating in the region of 100 kV; (2) improved penetration power of electrons in matter; (3) improved chromatic aberration, assuming highly stabilized high voltage and lens currents; (4) greater accuracy in electron diffraction techniques; (5) improved dark-field observation of both crystalline and amorphous materials; (6) use of other contrast mechanisms; (7) less radiation damage to thin biological specimens, more to thick metal specimens; (8) investigation of living cells and complete molecules in their natural form; and (9) high pressure gas reactions without excessive beam deterioration. Also considered are the effects available only at energies of over 1 MeV such as scattering from free nuclei, Cerenkov radiation, electron positron pair production, and nuclear reactions. Four types of motion for manipulating the specimens are examined: extended manual controls, mechanical activation from servomotors, hydraulic controls, and piezoelectric movements. M.G.J.

N67-33793# University of Southern Calif., Los Angeles.
MECHANISMS FOR CONTRAST FORMATION IN HIGH-VOLTAGE MICROSCOPY
David B. Wittry *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 79–84 (See N67-33781 19-14)

Transmission electron microscopy techniques are examined in relation to normal specimen position such as transition electron microscopy and ancillary techniques involving selected area diffraction, energy loss spectra, and Kikuchi line patterns. The possibilities of new specimen techniques are also assessed with consideration given to electron diffraction of surfaces, emission microscopy, reflection microscopy, back-reflection diffraction, and scanning electron microscopy or electron probe microanalysis. A schematic diagram is included to show various types of signals that can be generated in a thick specimen by an electron beam. The question of the usefulness of these signals at energies above 1 MeV is raised. Contrast sources are described, with staining or tracer methods believed equally applicable to all. It is pointed out that some of the mechanisms for contrast formation at 1 to 5 MeV should be evaluated before extensive development of the high voltage electron microscope, and that the technical feasibility of an instrument covering a wide range of magnification at 5 MeV must be investigated. M.G.J.

N67-33794# Argonne National Lab., Ill.
RECORDING SYSTEMS FOR THE HIGH-VOLTAGE ELECTRON MICROSCOPE
John Gilroy *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 85–92 refs (See N67-33781 19-14)

Summary information and schematic representations are presented on suggested image recording mechanisms. Consideration is given to the problems involved in utilizing the full energy of a 5 MeV electron directly and effectively. These include: (1) the effective image size for 5 MeV primaries in various thicknesses of materials and the accompanying radiation loss; (2) the difference in the photographic problem for electrons of 100 keV and 5 MeV; (3) a large fiber optic screen coupled to a small fiber optic image intensifier by an oil film of matching refractive index to allow inspection of a large field of view by moving the intensifier across the stationary viewing screen; (4) differential pumping of ultrahigh microscope column for use with photographic plates; (5) image production by fluorescence; and (6) optical fluorescence in image production. For scanning systems, a multiplicity of operating modes is considered essential. It was also felt that numerous display systems should be available, such as energy loss image displays, energy scanning showing the energy loss for small areas, multiple-energy level displays, and Y-modulation. Consideration was given to data handling problems, with a multiple detector system proposed. M.G.J.

N67-33795# Argonne National Lab., Ill.
GENERAL CONSIDERATIONS FOR ELECTRON-MICROSCOPE COLUMNS
Raymond K. Hart *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 98–99 (See N67-33781 19-14)

Various design configurations for a 3 and 5 MeV electron microscope column are briefly described. These include: (1) a two-column arrangement using two Linac-charged high voltage systems, with bending magnets deflecting the beams from these Linacs to the charging domes of the high voltage systems of either microscope; (2) a 3 MeV column with the conventional lenses bolted together to produce a rigid column; and (3) a vacuum housing for conventional and superconducting lenses, with shelves used to support individual column components. M.G.J.

N67-33802# Reading Univ. (England).
THE MAGNETIC SPECTROMETER AS A VOLTAGE STABILIZER
T. B. Rymer *In* Argonne Natl. Lab. Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 124–130 refs (See N67-33781 19-14)

Operational details are given on the magnetic spectrometer which is based on the principle of semicircular focusing in a magnetic field. A theoretical analysis of the analyzer is presented. Other aspects of the device are also considered, such as the lack of parallelism of knife edges, current–voltage distributions with parallel and nonparallel knife edges, leakage current with nonparallel knife edges, beam positioning with respect to knife edges and the effect of errors, roughness of knife edge, power dissipation at knife edges, and the effect of inhomogeneities of the magnetic field. In considering the possibility of using the spectrometer as an energy analyzer, it is concluded that the analyzer has an energy resolution worse by a factor of 16 than a conventional double-slit spectrometer of the same diameter. M.G.J.

N67-33803# Argonne National Lab., Ill.
A SUPERCONDUCTING MAGNETIC SPECTROMETER
Martyn H. Foss (Carnegie Inst. of Tech.) and Charles Laverick *In its* Proc. of the AMU-ANL Workshop on High-Voltage Electron Microscopy [1966] p 131 ref (See N67-33781 19-14)

A typical design is proposed whereby a magnetic spectrometer may be used to determine the energy spectrum of an electron beam and then act as a high voltage power supply stabilizer. It is pointed out that stability can be increased by several orders of magnitude if superconducting windings are used, and a truly superconducting joint can be fabricated. In the suggested configuration, D-shaped coils are inserted at the top and bottom of the gap, and the central space is for the vacuum chamber. A peak central field of about 3 kG is required, necessitating a minimum

of 5000 amp-turns/coil. Using heat-treated, 0.25 mm diameter, copper-coated Nb–33% Zr wire, it is considered possible to operate at wire current as high as 250 A so that only 20 turns would be required for each coil. M.G.J.

N67-33808# Argonne National Lab., Ill.
CONVENTIONAL MAGNETIC LENSES
Raymond K. Hart *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 140–143 refs (See N67-33781 19-14)

As the objective lens is considered to be most important in an electron microscope, details are given on strong lenses containing pole-piece inserts. It is pointed out that the performance of a magnetic lens depends on its pole piece, with the important parameters being the radii of the bores and the spacing between them. The values for these parameters for 100 kV microscopes range from 2.5 to 7.0 mm. Third-order aberrations causing image defects due to geometrical effects of the refracting fields are listed as spherical aberration, distortion, anisotropic distortion, field curvature, astigmatism, anisotropic astigmatism, coma, and anisotropic coma. Other aberrations causing image defects are identified as chromatic aberration, rotational chromatic aberration, and space-change distortion. Of these, spherical aberration, astigmatism, and chromatic aberration are considered the most important; each is discussed briefly, and defined mathematically. Consideration is also given to a single-field condenser objective lens developed to increase resolution. Operating parameters for a 5 MeV cylindrical lens are given, and a schematic is included. M.G.J.

N67-33809# Hitachi, Ltd., Tokyo (Japan).
CONVENTIONAL 3 MeV AND 5 MeV ELECTRON-MICROSCOPE DESIGN
Bunya Tadano *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 144–153 refs (See N67-33781 19-14)

A first order estimation is presented on the design of a 3 MeV electron microscope, with the conditions stated for designing both conventional and superconducting lenses. The actual values adopted for the objective lens design are given. Parameter variations with ampere turns are listed. Plots depict the variation of spherical aberration and resolution with accelerating voltage, and the maximum magnetic-flux distribution to determine the configuration of a second objective lens. Image defects due to instrumental instabilities are analyzed. Design data are also provided on electron beam alignment, first and second condenser lens, magnetic deflector for dark field illumination, selected area diffraction, and electronic magnification. A zero order estimation is provided on the 5 MeV electron microscope design. Design requirements for short focal length lens are listed, and the problems involved in superconducting lens construction are identified. The features of high voltage electron microscope are assessed in relation to theoretical resolution, penetrating power, specimen damage, electron diffraction accuracy, and chromatic aberration. M.G.J.

N67-33810# Argonne National Lab., Ill.
CURRENT SUPERCONDUCTING LENS STUDIES FOR ELECTRON MICROSCOPES
Bunya Tadano (Hitachi, Ltd.) and Charles Laverick *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 154–159 (See N67-33781 19-14)

An overview is presented on the various approaches taken in assessing the possibilities of using superconductors in electron microscope lens designs. A cryo-electron microscope optical bench system is being investigated, which uses high field superconducting niobium–zirconium solenoid lenses in liquid helium dewars. These operate at 4 to 32 kG without pole pieces and with modified objective and objective–projector pole pieces. Also being studied are special superconducting objective lens in liquid helium cryostat, which may be used as an integral part of cryo-electron microscopes or to replace the objective lens in modified high resolution, commercial electron microscopes. Preliminary experiments on superconducting lenses were carried out using copper-plated, nylon-covered Nb-25 Zr or Nb-40 Zr-10 Ti superconducting wires. In other experiments, the diffraction chamber of the 500 kV electron microscope was replaced by a superconducting lens. The microscope was used as a two-lens system, with the superconducting lens as an objective lens and a conventional second projector lens. Summary test data are given on tests with a Nb_3Sn ribbon coil, and Nb_3Sn deposited on platinum discs. M.G.J.

N67-33811# Carnegie Inst. of Tech., Pittsburgh, Pa.
HIGH-FIELD SUPERCONDUCTING LENSES
Martyn H. Foss *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 160–162 (See N67-33781 19-14)

Differences inherent in the design and construction of conventional lenses and of high field lenses are delineated, with precision in coil design and construction identified as the important parameter in lens precision. An example is given to show some of the problems in lens design, supported by figures depicting the arrangement and calculated field profiles for a bell-shaped high-field system using clipping coils, and a coil system to give short half-width by means of adjacent coils operated in reverse current. It is emphasized that the coil must be designed so that undesired fields are not generated, and that low-order errors are eliminated, and must be so constructed that leads, accurate wire size, and other details are carefully arranged. An optimum protection system is considered important due to the high current density required in a microscope lens. Test methods to check conductor design are suggested. M.G.J.

N67-33812# Cambridge Univ. (England).
QUADRUPOLE LENS PROPERTIES
Peter W. Hawkes *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 163–164 (See N67-33781 19-14)

A quadrupole system is defined in terms of an astigmatic or anamorphotic system; it is considered equivalent to a round lens if it produces a stigmatic and orthomorphic image for all pairs of conjugate (object and image) planes without any changes of excitation or spacing. The properties of individual systems are assessed for the single quadrupole, symmetrical and unsymmetrical doublets, symmetrical and unsymmetrical triplets, mirror symmetry quadruplet, quadruplet with mirror symmetry +90° rotation, and the unsymmetrical quadruplet. Requirements for the various kinds of lenses are mentioned in relation to the condenser, objective lens, and projector lens. M.G.J.

N67-33813# Aerojet Delft Corp., Plainview, N. Y.
QUADRUPOLE–OCTUPOLE CORRECTION SYSTEM
J. H. M. Deltrap *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 165–169 refs (See N67-33781 19-14)

The possibility of correcting the spherical aberration of a round lens by means of a quadrupole–octupole system is considered, and a preliminary design of such a system is presented. Data on optimum lenses for 1, 2, 3, and 5 MeV are provided, and the performance characteristics of the 1, 2, and 3 MeV lenses when used with a 5 MeV beam are given. Also listed are the performance characteristics of the 2 MeV lenses when used at 0.5, 1, 2, 3, and 5 MeV. Two- and three-power telescopic systems that could effectively reduce the focal length of the round lens are discussed. The physical parameters for the quadrupole design are delineated, and quadrupole–octupole combinations and correctors are described. First-order equations for a rectangular model were solved to determine the aberrations of the system. Preliminary findings on required tolerances are summarized. It is concluded that, with one

lens optimized for some intermediate beam potential, the correction system can be used over the complete range from 0.5 to 5 MeV. M.G.J.

N67-33814# Argonne National Lab., Ill.
GENERAL COMMENTS ON THE AMU–ANL ELECTRON MICROSCOPE WORKSHOP LENS-DESIGN CONSIDERATIONS
David Cohen (Chicago Univ.) and Charles Laverick *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 170–172 (See N67-33781 19-14)

Consideration is given to the conventional cylindrical lenses, superconducting cylindrical lenses, and several quadrupole–octupole system types. It is pointed out that although cylindrical lenses have been used almost completely in electron microscopes, the newer systems offer greater potential such as the application of superconductors to lens design problems, and the development of high quality multiple pole systems. Important criteria in magnetic lens design are defined: (1) Lens aberrations must be reduced as much as possible. (2) The highest degree of stability in magnet current should be attained. As many multipole systems show promise for use in electron microscopes, typical lens designs are compared for the 5 MeV objective lens systems. Pictorial data are included on the theoretical resolution versus accelerating voltage for various voltage stabilities, a 3 MeV conventional lens design, and a superconducting lens system. M.G.J.

N67-33815# National Bureau of Standards, Washington, D. C.
GENERAL CONSTRUCTION—A DISSENTING OPINION
L. L. Marton *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 173 (See N67-33781 19-14)

Rebuttals are presented to the ultraconservative viewpoints on the guidelines adopted for constructing the high voltage electron microscope. It is proposed: (1) Pertaining to flexibility, shielding problems should be divorced from other problems, and remote control means should be relied on for all operations connected with the manipulation of the instruments. (2) For radiation shielding, wall coating with magnetically shielding materials is cheaper than a solid steel enclosure for the optical parts. (3) Hydraulic means can be used for remote control. (4) Horizontal arrangements permit more accessibility to the components for servicing and replacement. M.G.J.

N67-33816# Kyoto Univ. (Japan).
ENHANCEMENT OF PHOTOGRAPHY OF HIGH-VOLTAGE ELECTRONS
H. Hashimoto *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 174 refs (See N67-33781 19-14)

Four methods are suggested for improving the sensitivity of photographic film to high energy electrons: (1) As fluorescence of emulsion and substrate film are important in film sensitivity, using fluorescent basal film as well as fluorescent emulsion may be helpful. (2) The use of lead bromide in emulsion may lower the sensitivity to light but increase the sensitivity to X-ray and high energy particles. (3) The chemical deposition of a thin layer of gold particles may increase the photographic effect of high speed electrons. (4) The krypton ^{19} may be included in the emulsion to increase the ionization process. M.G.J.

N67-33818# Argonne National Lab., Ill.
NOTES ON A SURVEY OF DIGITAL AND RELATED TECHNIQUES
Charles E. Cohn *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 177 (See N67-33781 19-14)

Comparative present and expected data on digital devices are tabulated, and summary information on motion transducers is presented. Possible transducer usage with digital devices is depicted. It is pointed out that a reasonably accurate theoretical model of the influence of position of elements, etc., on a microscope, combined with digital sensors and drives, might make computer-governed alignment preferable to manual alignment. Author

N67-33821# Argonne National Lab., Ill.
MAGNETIC-TAPE STORAGE SYSTEM FOR SCANNED IMAGES
Charles E. Cohn *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 182 (See N67-33781 19-14)

A magnetic-tape system is proposed, and block diagram of the system is shown. The heart of the system is a recirculating magnetic-tape loop, long enough to store the information from one complete scan. This tape carries two tracks, one with the video data, the other with a clock pulse for each picture element scanned. As each picture element is scanned, the video information for that element accumulated from previous scans is read off the data track, added to the video signal from the current scan, and rewritten on the erased tape. The information may be continuously monitored by a picture tube scanned in synchronism with the scanning microscope. Author

N67-33822# Argonne National Lab., Ill.
PROPOSED EXPERIMENTS TO STUDY DETECTION OF HIGH-ENERGY ELECTRONS
Charles E. Cohn and J. H. Roberts (Northwestern Univ.) *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 183 refs (See N67-33781 19-14)

Experiments are suggested to test the crucial points in the problem of detecting single electrons with adequate spatial resolution in the detector of a 5 MeV electron microscope. Studies indicate that a system consisting of a thin (≈0.1 mm) scintillator, such as cesium iodide, coupled optically to an image orthicon, would be satisfactory. A series of experiments is considered necessary as a guide to the performance of certain elements common to most of the useful detection schemes. Other recommendations include: (1) a simple experiment using β-ray and spectrometer to expose nuclear emulsion to monoenergetic 5 MeV electrons; and (2) a Van de Graaff generator producing 5 MeV electrons to test the radiation damage produced in scintillators, fiber optics, and multiplier systems, and the buildup of space charge in detector materials. M.G.J.

N67-33823# Cambridge Univ. (England).
SUGGESTIONS ON IMAGE OBSERVATION
William C. Nixon *In* Argonne Natl. Lab. Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 184 refs (See N67-33781 19-14)

For magnified image observation, it is suggested that a fiber optic faceplate, available up to 30 cm diameter, be coupled to a fiber optic input, three-stage image intensifier by using a thin film of immersion oil, with the image intensifier moved across the fiber optic and window to inspect a larger image than covered by the intensifier. It is also suggested that scanning electron diffraction should be available on the main microscope column for readout of crystalline information. An energy analyzer, both for thin films and for solids, is considered necessary. The point is made that scanning electron microscopy need not involve a second column; a very fine electron microscope exists in the back focal plane, and has been used in static form in an attempt at electron holography. The recommendation is made that an adjustable aperture be placed in the projector lens bore to act as a differential pumping hole, separating the ultrahigh vacuum of the column necessary for field emission from the normal high vacuum of the recording area. Other recommendations include scanning electron microscopy of solids at high voltage. M.G.J.

N67-33824# Argonne National Lab., Ill.
ELECTRICAL SERVICE PROVISIONS TO MINIMIZE STRAY FIELDS
Charles E. Cohn *In its* Proc. of the AMU–ANL Workshop on High-Voltage Electron Microscopy [1966] p 185 (See N67-33781 19-14)

As the proposed 5 MeV microscopy would require considerable magnetic shielding to minimize defocusing by stray alternating magnetic fields, originating from electrical power apparatus and wiring in the vicinity, the following measures are suggested. (1) The building should be located as remotely as possible from major power lines, accelerators, etc. (2) Generation of stray fields within the building could be minimized by using dc instead of ac power. (3) Unusual wiring practices would be desirable. (4) Transformers, substations, motor generators, rectifier sets, etc. should be located as remotely as possible, despite increased wiring losses. Author

N67-33829# California Univ., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Progress Report, Sep.–Dec. 1966
[1967] 58 p refs *Its* Index to Hazards Control Progress Rept. no. 24 through 26
(Contract W-7405-ENG-48)
(OCRL-50007-66-2; PR-26) CFSTI: HC $3.00/MF $0.65

Radiation laboratory work on hazards control, decontamination, waste disposal, and nuclear safety measures are reported. Fire safety, air sampling, radiation accidents, industrial safety and ventilation, personnel monitoring and whole body counting were evaluated by radiation detection instruments. Also described are nuclear and theoretical physics research on such topics as: beta-ray spectrometry, gamma ray spectroscopy, hydrogen explosion protection measures, neutron capture gammas, thoron and radon experiments, and plutonium survey with X-ray detectors. R.U.

N67-33859# Atomic Energy Board, Pretoria (South Africa).
Ge(Li)-DETECTORS: A REVIEW OF THEIR PROPERTIES AND OF THEIR APPLICATION IN GAMMA SPECTROMETRY
P. W. de Lange and G. C. Snyman Dec. 1966 26 p refs
(PEL-135)

The properties of planar and coaxial Ge(Li)-detectors in γ-ray spectroscopy are reviewed. Three different cryostat systems to operate Ge(Li)-detectors at low temperatures are compared. Recommendations are proposed for would be users of this new tool in γ-spectrometry. Author (NSA)

N67-33896# Imperial Coll. of Science and Technology, London (England). Dept. of Geology.
THE HELIUM MAGNETOMETER
M. J. Usher 1966 40 p refs Sponsored by Brit. Natl. Comm. on Space Res.
(Rept.-1966/3) CFSTI: HC $3.00/MF $0.65

Of the various types of magnetometers available for rocket and satellite experiments, those using the optical pumping technique have distinct advantages. These lie in the digital form of the output, giving high sensitivity and freedom from drift due to temperature or other causes. Magnetometers have been developed employing optical pumping of rubidium, cesium and helium, and this report relates to the development of a self-oscillating helium instrument. Details are also given of a station magnetometer using the locked oscillator technique. Author (ESRO)

N67-33906# Emmanuel Coll., Boston, Mass. Oriental Science Library.
AN INSTRUMENT FOR DETERMINING THE SPECTRA OF THE ELECTRIC CHARGE OF CLOUD DROPLETS
Chao Yen-Tseng, Shih Wei-Guang, and Chen Shi-Ming Bedford, Mass., AFCRL, Feb. 1967 23 p refs Transl. into ENGLISH from Chi Hsiang Hsueh-Pao (Peking), v. 34, no. 4 Nov. 1964 p 531–538
(Contract AF 19(628)-5073)
(EMM-66-129; AD-653970) CFSTI: HC $3.00/MF $0.65

The paper describes the design, construction and calibration of a simple instrument for determining the spectra of the electric charge of cloud droplets. The instrument was used to evaluate the spectra of the electric charge of droplets produced by sprays from the domestic water supply in a cloud chamber. A preliminary analysis of the results was made. Author (TAB)

N67-33936# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALOG-DIGITAL DEVICE FOR MODELING PROBLEMS OF NONSTATIONARY THERMAL CONDUCTIVITY [ANALOGO TSIFROVOYE USTROYSTVO DIYA MODELIROVANIYA ZADACH NESTATSIONARNOY TEPLOPROVODNOSTI]
V. V. Il'in, G. I. Vasil'yev, I. B. Novikov and R. P. Tevelova 23 Jan. 1967 7 p Transl. into ENGLISH from Russian Patent No. 175750 (Appl. no. 912383/16-24, 18 Jul. 1964) p 1–2
(FTD-HT-66-712; AD-653551) CFSTI: HC $3.00/MF $0.65

The device contains a network of ohmic resistances and a device for setting the boundary conditions. To increase the accuracy of simulation, the device contains a code-to-analog converter for each node, which operates alternately in a storage and a voltage setting mode. There is also one analog-to-code converter common to all the nodes, which is connected sequentially through an electronic switch to the nodes of the network. Codes proportional to the voltages at these points are supplied to the inputs of the code-to-analog converters operating in the storage mode. Author (TAB)

N67-33959# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
NEW SYSTEMS OF TRAJECTOGRAPHY [NOUVEAUX DISPOSITIFS DE TRAJECTOGRAPHIE]
Roland Moreau 1967 39 p refs In FRENCH Presented at the Meeting of the Soc. Franc. des Electroniciens et Radioelectriciens, Paris, 21 Nov. 1966
(ONERA-TP-446(1967)) CFSTI: HC $3.00/MF $0.65

Two systems, one based on atomic clocks and the other on lasers are considered. Atomic clocks open the way to systems of trajectography which are theoretically very simple. The principle investigated includes the possibility of using, on the vehicle and on the ground, oscillators remaining synchronous for the total duration of the experiment. Ruby lasers eventually associated to passive transponders may constitute high precision range-finders which may be used to determine the trajectories of various vehicles. Experimental stations based on the two principles are described. Author (ESRO)

N67-33987# Royal Aircraft Establishment, Farnborough (England).
AN AUTOMATIC THREE-DIMENSIONAL MODELS MEASURING MACHINE IN R.A.E. WORKSHOPS
S. W. Potter, W. G. Bushell, and E. H. A. Fewkes Jul. 1966 25 p refs
(RAE-TR-66229) CFSTI: HC $3.00/MF $0.65

The introduction of numerical control into the inspection of Aircraft Models by the development of a special measuring machine. A description is given of its construction, the system for controlling precise movements, the method of output information and the method of operation. The considerable reduction in the time for measuring the contour of a model on a predetermined grid pattern is recorded in the form of examples. Improvements subsequently incorporated in the machine together with suggestions for further development are recorded. Author (ESRO)

N67-33989*# Arizona Univ., Tucson.
PRELIMINARY DESIGN FOR A MULTI-SPECTRAL TRACKING TELESCOPE (MSTT)
P. N. Slater April 1967 17 p refs
(Contract NSR-03-002-086)
(NASA-CR-87313; TR-17) CSCL 17H

Progress is reported in the optical design of a multi-spectral tracking telescope for the Apollo Applications Program. Considerable emphasis was placed on designing as fast a system as possible to reduce the problem of compensating for image motion. The optical system is all-reflecting, and operates at F/5 (T/7) or F/8 (T/8.4) with a static angular resolution of 0.8 arc seconds over a 1.5 total field of view. A high performance potential of the final design was obtained, and resulted from modifications to a new and unconventional three-mirror design. Briefly, the system is diffraction-limited with an angular resolution of 0.2 arc seconds over its entire 1.75° field. Areas covered in the design description include system parameters, optical performance, effects of central obscuration, and performance-degrading factors. C.T.C.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-32736# Mechanical Technology, Inc., Latham, N. Y.
CALCULATION OF ELASTOHYDRODYNAMIC FILM THICKNESS IN HIGH SPEED ROLLING AND SLIDING CONTACTS
H. S. Cheng May 1967 106 p refs
(Contract N00014-66-C-0037)
(MTI-67TR24; AD-652924) CFSTI: HC $3.00/MF $0.65

A Grubin type inlet film thickness analysis including the full thermal effects is developed. The temperature distribution in the inlet region where the reverse flow exists is calculated by a repetitive forward and backward marching procedure. Results are obtained for wide ranges of loads, speeds and lubricant parameters. These cover extremely high speed ranges for which no results were available previously. The reduction of film thickness due to thermal effects is accounted by a thermal reduction factor, which is defined as the ratio of the actual film thickness to that calculated by isothermal theories. Design charts are presented in terms of the thermal reduction factors. A design procedure to calculate film thickness for high speed, heavily loaded contacts is developed and two numerical examples are included. Author (TAB)

N67-32741# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
[URANIUM FABRICATION] Semiannual Progress Summary, Jul.–Dec. 1965
1 Dec. 1966 43 p refs
(Contract AT(30-1)-1405)
(RMI-7) CFSTI: HC $3.00/MF $0.65

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2. PROJECT 010-1—BILLET PREPARATION BY PIERCING. PIERCING IN THE GAMMA TEMPERATURE RANGE C. A. Scharschu p 11–20 ref (See N67-32743 19-15)

3. PROJECT 263—EXTRUSION COOLING. WATER QUENCHING OF URANIUM EXTRUSIONS E. J. Carozza p 21–28 (See N67-32744 19-15)

4. PROJECT 303—NPR FABRICATION. NPR BILLET FORGING REPORT U-321 AND U-323 H. G. Carmichael and E. J. Carozza p 29–35 refs (See N67-32745 19-15)

N67-32742# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
PROJECT 003-2—URANIUM FABRICATION FOR SRO. EXPERIMENTAL DESIGN PARAMETERS FOR THE HOT PRECISION EXTRUSION OF URANIUM TUBING FOR REACTOR FUEL ELEMENTS
C. A. Scharschu *In its* [Uranium Fabric.] 1 Dec. 1966 p 2–10 (See N67-32741 19-15)

It is reported that an evaluation was made of the possible reduction of extruded overstock of .100" on both O.D. and I.D. and the accompanying cost savings. Estimates showed significant savings could be expected by extrusion to the .025" overstock level. A brief summary is presented of the analysis of known sources of dimensional and surface quality variation and of known means of controlling the variability from each source. N.E.N.

N67-32743# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
PROJECT 010-1—BILLET PREPARATION BY PIERCING. PIERCING IN THE GAMMA TEMPERATURE RANGE
C. A. Scharschu *In its* [Uranium Fabric.] 1 Dec. 1966 p 11–20 ref (See N67-32741 19-15)

Experiments on piercing a 2" hole in alpha and gamma heated billets and on piercing a 4-1/2" hole in alpha heated billets are reported. The procedures are outlined, and the results of individual runs are discussed. For the 2" hole, piercing of alpha preheated billets appears to be more practical than piercing with a blank, and tooling misalignment seems to be the most critical factor in piercing concentricity. The results of gamma piercing are considered promising but not the answer to the eccentricities. For the larger hole, piercing pressure was realized, but the results are considered disappointing, due to extreme distortion in the ingot shape after piercing. N.E.N.

N67-32744# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
PROJECT 263—EXTRUSION COOLING. WATER QUENCHING OF URANIUM EXTRUSIONS
E. J. Carozza *In its* [Uranium Fabric.] 1 Dec. 1966 p 21–28 (See N67-32741 19-15)

A method was developed whereby uranium extrusions could be water quenched to eliminate excessive oxidation during cooling. Exceptional dimensional control was made possible and a considerable cost savings was also realized on routine production. The door was also opened to a precision extrusion operation of bare uranium billets and even larger cost savings potentials. Author

N67-32745# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
PROJECT 303—NPR FABRICATION. NPR BILLET FORGING REPORT U-321 AND U-323
H. G. Carmichael and E. J. Carozza *In its* [Uranium Fabric.] Dec. 1966 p 29–35 refs (See N67-32741 19-15)

Investigation of the upset-forge route for NPR-NOE processing was continued. Several process variables introduced in recent experiments proved promising. Work to date indicates the practicality

of upset-forging as a production practice for the NPR-NOE fuel element size. Results justify expanding the program to include the NPR-NIE size. Author

N67-32787# Technische Hochschule Munchen (West Germany). Institut fuer Werkzeugmaschinen und Betriebswissenschaften.
EFFECT AND CONTROL OF CHATTER VIBRATIONS IN MACHINE TOOL PROCESSES Quarterly Technical Report, 1 May–31 Jul. 1966
Klaus Corbach, Heinrich Dzaack, Hans Dirmeier, and Saripalle Satyamurty 31 Aug. 1966 44 p
(Contract AF 61(052)-961)
(QTR-1; AD-652493)

Within the scope of a general statistical evaluation of test data available from investigations into the dynamic behaviour of several machine tools, seventeen case reports concerning the knee type milling machines have been studied with a view to ascertain the feasibility of specifying some characteristic quantities as critical to machine performance. The experience gained with these machines showed the necessity of a well differentiated specification for the machine behaviour, as is assured with the Multiplex method. Some salient aspects with respect to the functional details of some parts of the electronic equipment developed to measure the cutting stiffness are presented. The individual units of this instrumentation are designed in such a way that a variety of measuring and computing tasks can be fulfilled. The problems arising in the layout of an amplitude controlled RC-Generator using a pulse duration modulator, novel continuously tunable RC-networks synchronously driven through diode switches and other elements are discussed. TAB

N67-32804 Joint Publications Research Service, Washington, D. C.
METAL TREATMENT PROCESSES
30 Jun. 1967 7 p ref Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 5, 1967 p 82–88
(JPRS-41651; TT-67-32284) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. ROLLING HIGH MELTING METALS IN AN INERT CONTROLLED ATMOSPHERE A. Ya. Borisov, V. I. Shekalov, M. A. Gertsky, and T. A. Aleksandrov p 1–3 (See N67-32805 19-15)

2. OPERATION OF A HIGH TEMPERATURE VACUUM ANNEALING FURNACE Ye. Yu. Tret'yakov, S. G. Khoets'yan, and N. S. Il'in p 4–7 (See N67-32806 19-15)

N67-32805 Joint Publications Research Service, Washington, D. C.
ROLLING HIGH MELTING METALS IN AN INERT CONTROLLED ATMOSPHERE
A. Ya. Borisov, V. I. Shekalov, M. A. Gertsky, and T. A. Aleksandrov *In its* Metal Treatment Processes 30 Jun. 1967 p 1–3 (See N67-32804 19-15)

The possibility of hot rolling metals in large chambers filled with a controlled inert gas and the dependence of gas saturation on heating temperature were investigated. The chamber is 44 m^3 in volume, is filled with commercially pure argon, and has a purification unit which assures the removal of mechanical impurities, moisture, and vapors of oil, oxygen, and hydrogen. The gas saturation of the rolled niobium, titanium, and molybdenum was determined by weight changes after heating to 1200°C and after rolling. It was found that there was no adhesion of the metals on the working tools. It is concluded that the purification system is satisfactory and that the hot plastic treatment is feasible. N.E.N.

N67-32806 Joint Publications Research Service, Washington, D. C.
OPERATION OF A HIGH TEMPERATURE VACUUM ANNEALING FURNACE
Ye. Yu. Tret'yakov, S. G. Khoets'yan, and N. S. Il'in *In its* Metal Treatment Processes 30 Jun. 1967 p 4–7 (See N67-32804 19-15)

The procedures for operating the high temperature, high vacuum furnace for annealing semifinished materials and products of high purity, high melting metals are briefly outlined. The effect of high vacuum annealing on the gas content was determined for batches of vanadium and tantalum products, and the data are tabulated. It was found that degasification accompanies the annealing, and that the high temperature, high vacuum combination increases the size of the grains, indicating that the degasification takes place below the surface layers as well as on the surface. N.E.N.

N67-32893# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
A STUDY OF OIL CIRCULATION IN THE R4 SPIN-AXIS BEARING WITH SINTERED NYLON BALL RETAINER
Martin Roberts Dec. 1966 26 p refs
(Contract AF 33(615)-2243)
(E-2082; AD-652843)

A study was conducted on the circulation of lubricants in the R-4 spin-axis gyro bearing. The flow of lubricant was traced by incorporating 1% anthroquinone dye in the lubricant impregnated in an isolated portion of the sintered nylon retainer and periodically observing the color change of the undyed section as the lubricant was transported. Flow rates were determined for variations in speed, preload, bearing geometry, ambient pressure, lubricant viscosity and surface tension, retainer permeability, and the use of an antimigration barrier film. At 24,000 rpm and 7 pounds preload, an average circulation rate for Teresso V-78 was 45 micrograms/hour, which is equivalent to an average residence time of 2 hours on the metal raceways. The most important factor influencing circulation was the retainer permeability. Author (TAB)

N67-32969# Marine Engineering Lab., Annapolis, Md.
LUBRICATION OF TITANIUM STATE OF THE ART
Joanne R. Burns May 1967 21 p refs
(NSRDC-138/67; AD-652001) CFSTI: HC $3.00/MF $0.65

The advantages of using titanium in marine machinery are outlined, and the difficulty in lubricating machinery constructed of titanium is reviewed. A number of suggestions are given for possible research which might lead to the successful lubrication of titanium machinery components in a marine environment. TAB

N67-32973*# Southern Research Inst., Birmingham, Ala. Metallurgy Div.
STUDY OF DEVELOPMENT OF SATURN MANUFACTURING TECHNOLOGY FOR WELDING METHODS AND TECHNIQUES TO REDUCE HYDROGEN POROSITY Final Report, 25 Feb.–24 Sep. 1966
A. Clyde Willhelm 28 Oct. 1966 58 p refs
(Contract NAS8-20307)
(NASA-CR-87304; Rept.-8086-1806-VII) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A literature study and several series of welding experiments were performed to determine the feasibility of using various elements as getters and removers of hydrogen to prevent or reduce hydrogen-induced porosity in the inert-gas arc welding of aluminum alloys. Arc spot-welding experiments were performed with four getter materials (Ti, Zr, Ce, and Cs) that were chosen as most promising from the results of the literature study on hydride-forming characteristics. Despite several methods of application of the getters, including mixes with various vehicles as carriers, compaction in small drilled holes, compaction in shallow depressions, compression

between halves of butt joints, and deposition and drying (at 400°F) on the surface in slurry form. the results were essentially negative. It was concluded that hydrogen porosity in aluminum welds would not be prevented by the getter technique if conventional welding procedures are used. However, there was an indication that some of the getters did attract hydrogen and might have been effective had they not alloyed and carried the hydrogen into the weld nugget. Therefore, it was recommended that further welding studies be preceded by a study of the comparative hydrogen-attracting properties of molten aluminum and prospective getters of various form and content under heat conditions expected to exist in the arc and at the weld-nugget surface. Author

N67-33019*# Mechanical Technology, Inc., Latham, N. Y.
ANALYSIS, DESIGN, AND PROTOTYPE DEVELOPMENT OF SQUEEZE-FILM BEARINGS FOR AB-5 GYRO. PHASE IV: DEVELOPMENT OF A CONICAL-BEARING, AXIAL EXCURSION PROTOTYPE Summary Report
F. K. Orcutt and C. H. T. Pan Apr. 1967 44 p refs
(Contract NAS8-11678)
(NASA-CR-87280; MTI-67TR30) CFSTI: HC $3.00/MF $0.65
CSCL 13I

Development of a preliminary prototype squeeze-film bearing system that would ultimately be suitable for gimbal axis support of an AB5 size gyro is discussed. For a given bearing surface geometry and mean-gap between surfaces, the bearing load capacity and stiffness increase with increased vibration amplitude. Or, stated another way, specified bearing load capacity and stiffness can be achieved with a larger mean gap if the vibratory motion amplitude is increased. For this reason, the effort to develop a squeeze-film bearing support centered on the development of the transducer system which provides the high-frequency vibratory motion of the bearing surfaces. Author

N67-33042# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
EFFECTS OF GRINDING ON CERTAIN CRYSTALLINE STRUCTURES [INFLUENCE DU BROYAGE SUR QUELQUES STRUCTURES CRISTALLINES]
Yusuf Tekiz (Ph.D. Thesis—Paris Univ.) 1966 61 p refs In FRENCH; ENGLISH summary
(CEA-R-2868)

The effects of grinding on certain crystalline substances (ZnO, ZnB, Sb), have been studied using X-ray and electron microscopy. The treatments were carried out using a vibrating mill which involves a higher energy than more conventional equipment such as ball-mills. Various methods have been proposed for determining the width of the intrinsic profile (β). In the case of zinc oxide it has been shown possible to differentiate the respective contributions of the fragmentation effects and of lattice deformation effects to the overall effects of the grinding. For the two types of zinc sulfide (blend and wurtzite) it has been shown that the blend–wurtzite transition point is very much decreased, and that the rate of transformation of wurtzite into the stable form (blend) at room temperature is considerably increased by the grinding. In the case of antimony, the method of fragmentation shows the existence of an anisotropy which appears to be connected with easily cleavable planes. Author

N67-33048# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
[MARK V-B PROCESS IMPROVEMENT, NPR PROCESS IMPROVEMENT, BASIC EXTRUSION TECHNIQUES] Quarterly Progress Summary, Apr.–Jun. 1966
R. L. Bean 10 Oct. 1966 84 p refs
(Contract AT(30-1)-1405)
(RMI-6) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. EXTRUDABILITY VS. GRAIN STRUCTURE OF NORMAL URANIUM, SUMMARY C. A. Scharschu 48 p refs (See N67-33049 19-17)

2. IRRADIATION TEST RESULTS ON CORES HAVING "AS-EXTRUDED" COARSE GRAIN M. F. Garufi and C. A. Scharschu 3 p (See N67-33050 19-22)

3. NPR BILLET FORGING REPORT U-319 E. J. Carozza 3 p (See N67-33051 19-22)

4. STATUS REPORT ON EXTRUSION TEMPERATURE DETECTION J. C. Sonsini and C. A. Scharschu 32 p refs (See N67-33052 19-15)

N67-33052# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
STATUS REPORT ON EXTRUSION TEMPERATURE DETECTION
J. C. Sonsini and C. A. Scharschu *In its* [Mark V-B Process Improvement, NPR Process Improvement, Basic Extrusion Tech.] 10 Oct. 1966 32 p refs (See N67-33048 19-15)

An extensive evaluation was made of an infrared instrument to assess its capabilities for accurately determining and continuously recording the temperature and temperature variations of uranium tubes during extrusion. Factors considered include comparisons of the instrument readings versus thermocouple readings; the effects of target size and target distance; and an actual test during extrusion. Limiting conditions were explored, and a final design for the permanent installation on the extrusion press was determined. It was found that this instrument may be used as a reliable source of uranium extrusion temperature data on the exit end of the extrusion press. A method of transmitting the target temperature signal within the die head tunnel to the sensing instrument mounted outside the tunnel was also investigated. An aluminum tube with a highly polished inner diameter surface was used as a collimator and produced satisfactory results. M.G.J.

N67-33056# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTRODUCTION OF PLASMA TECHNOLOGY IN THE CHEMICAL AND METALLURGICAL INDUSTRY
V. Bzhozovskiy, Ya. Reda, and M. Mikos 21 Mar. 1967 24 p Transl. into ENGLISH of the book "Vnedreniye Plazmennoy Tekhniki v Khimicheskuyo i Metallurgicheskuyu i Promyshlennosti" Moscow, 1965 p 1–27
(FTD-MT-65-527; AD-653554) CFSTI: HC $3.00/MF $0.65

Installations with power from 30 to 100 kW which create plasma from argon, nitrogen, argon–hydrogen and nitrogen–water mixtures have been developed. The operation and parameters obtained at an installation with the power of 100 kW operating on nitrogen are described. The installation's contents are listed, mainly featuring a plasma gun. The gun's use is described in great detail and problems in its use are listed. Laminar flow in plasmatrons are cited. Methods for igniting the plasmatron are described. TAB

N67-33056# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLASMA PROCESSES IN METALLURGY AND PROCESSING OF MATERIALS
N. N. Rykalin and I. D. Kulagin 23 Mar. 1967 16 p refs Transl. into ENGLISH of the book "Plazmennyye Protsessy v Metallurgii i Obrabotke Materialov" Moscow, 1965 p 1–12
(FTD-MT-65-543; AD-653558) CFSTI: HC $3.00/MF $0.65

Methods of producing low-temperature plasma jets are considered. Energetic characteristics of plasma jets (power, enthalpy, temperature, efficiency) and methods for their approximate evaluation are given. Fields of plasma jet applications in material

processing (cutting, welding, surfacing, coating, spheroidizing) and metallurgical processes (ore decomposition, oxide reduction, melting) are considered. Author (TAB)

N67-33149# California Univ., Livermore. Lawrence Radiation Lab.
A SURVEY OF THERMAL EFFECTS IN MANUFACTURING
J. B. Bryan and E. R. McClure 6 Feb. 1967 52 p refs
(Contract W-7405-ENG-48)
(UCRL-50194) CFSTI: HC$3.00/MF$0.65

A survey of a variety of manufacturing facilities, with emphasis on those producing machine tools, has shown that thermal effects are considered a serious handicap to the achievement of precision. Methods of combating the thermal problem are varied and often are based on inadequate information. At present, achievement of precision is possible through time-consuming and costly processes mostly based on the adaptivity of human operators. With increased use of numerically controlled machine tools, the thermal effects problem will necessarily receive greater attention. Author (NSA)

N67-33340# General Electric Co., Schenectady, N. Y. Research and Development Center.
INVESTIGATION OF THE NATURE OF STRUCTURAL DAMAGE IN METAL-FORMING PROCESSES Final Report, Jan. 1966–Apr. 1967
H. C. Rogers and L. F. Coffin, Jr. Jun. 1967 79 p
(Contract NOw-66-0546-d)
(AD-653361) CFSTI: HC$3.00/MF$0.65

The present investigation is the third phase of a broad program undertaken with the goal of understanding the nature of structural damage during metal-forming processes and, in particular, the role of the hydrostatic component of the stress during deformation on the generation of such damage. Sheet drawing experiments were performed on 6061-T6 aluminum alloy, 60-40 unleaded brass, and ferrovac E under a variety of experimental conditions. The ability to assess the resulting damage in terms of changes in the density of the metals after drawing has been improved over that of previous studies by modifications in the density measuring facility. Among the improvements has been the adoption of diethyl phthalate as the immersion fluid replacing water and the development of a complete analytical expression for the density using the three-weighing techniques which factors in minor changes in temperature and air buoyancy. The results of drawing experiments on the aluminum alloy indicate that conditions producing the same state of hydrostatic stress at the midplane of the strip generate nearly comparable damage. There is a minor effect of die angle. The density of that portion of the strips near the midplane, where the stress state is most highly tensile, is substantially lower than the average strip density. TAB

N67-33410# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MACHINE BUILDERS HANDBOOK
Ye. V. Antoshin and I. L. Brinberg 13 Feb. 1967 740 p refs
Transl. into ENGLISH of the book "Spravochnik Mashingostroitelya" Moscow, Gos. Nauchnotekan. Iza. Mashinostr. Lit., 1963 p 1–451
(FTD-MT-64-192; AD-650549) CFSTI: HC$3.00/MF$0.65

The handbook contains technologies of foundry production, forging and stamping, welding production, thermal and chemical-heat treatment of metals, application of coatings on a machine part, and electrical, chemicomechanical, and ultrasonic methods of materials treatment. TAB

N67-33504# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
CORRECTING FORM ERRORS IN NUMERICALLY CONTROLLED MACHINED, POINT-DEFINED, SURFACES OF REVOLUTION
F. H. Broome and P. J. Anderson 15 May 1967 14 p ref
(Contract W-7405-ENG-26)
(IV-1576) CFSTI: HC$3.00/MF$0.65

Repeatable errors in parts manufactured by numerically controlled, single-point machining processes can now be corrected. By applying empirical corrections, developed from inspection data, to the contour description, form errors in the inner contour of an approximately four-inch-radius hemispherical copper assembly were reduced from 600 microinches total variation (±300 microinches from the desired dimension) to 200 microinches total variation (+120 microinches, −80 microinches from the desired dimension). The method can be readily applied to the APT programming system and is relatively inexpensive since, by using it, it is not necessary to rewrite the entire APT program. Author (NSA)

N67-33511# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
AUTOMATIC TOOL SETTING FOR NUMERICALLY CONTROLLED MACHINES
K. B. Reedy 22 May 1967 25 p refs
(Contract W-7405-ENG-26)
(Y-1579) CFSTI: HC$3.00/MF$0.65

An automatic tool-setting system was designed and installed on a Heald turning machine which was equipped with a Bendix Dynapath numerical control unit. Tape commands initiate an independent tool-setting cycle which automatically positions the machine slides to a fixed reference point relative to the datum and pole planes of the workpiece. When the tool-setting cycle is complete, control of the machine is returned to tape direction and the normal cutting cycle continues. Greater consistency of produced parts, increased accuracy, and reduced machining time per part are major advantages of this automatic tool-setting system. Author (NSA)

N67-33568* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
THE ELECTRIC AUTOMOBILE—ITS FUTURE
Manfred Altman 1967 15 p refs
(Grant NsG-316)
(NASA-CR-81776) CSCL 13F

This paper summarizes the current state of the relevant technology and presents a set of recommendations based on known capabilities. Estimates are made by comparing the performance characteristics and overall efficiency of the present internal combustion engine with those of feasible electric power sources. Requirements are stated in terms of electric energy capacity and power density. To meet energy and power requirements, fuel cell systems and system combinations are analyzed, including the following: hydrocarbon, Zn–air, Li–Cl_2, hydrogen–oxygen, and Na–S. Discussed are some technical aspects of the transition from internal combustion to electric power and the role of the federal government in the development of the electric automobile. It is concluded that a ten year transition to electric autos is desirable and feasible. The evolutionary process is expected to proceed from fleet vehicle to town car to high-performance car. Emphasis should be placed on rechargeable fuel cells rather than hydrocarbon fuel cells. K.W.

N67-33572# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
LUBRICATION OF BEARING STEELS WITH ELECTRO-PLATED GOLD UNDER HEAVY LOADS Technical Report, Jan.–Sep. 1966
Ritsu Takagi and Tung Liu Mar. 1967 23 p refs
(AFML-TR-67-61; AD-653974) CFSTI: HC$3.00/MF$0.65

The lubricating action of electroplated gold for 52100 steel and 440C stainless steel in sliding motion under a 150-pound

load was examined with a modified Alpha Tester (Model LFW-1). The advantage of gold plating was found to be entirely that of wear prevention while the sliding friction coefficient was not altered significantly. The wear lives of thick films were much longer than for thin films. A 20 film had a wear life of 150,000 revolutions. Too thick a film results in fatigue failure at the gold-steel interface. Silver, copper, and two gold alloys were found to be far less effective than pure gold as a lubricant while nickel was not at all effective. The failure of the plated film was usually marked by a rapid increase in wear rate. With thick gold alloy films, wear debris in the form of thin sheets were obtained in addition to the fine particles normally found with metallic films. The appearance of the wear tracks indicated that the gold films underwent considerable plastic deformation. Author (TAB)

N67-33634# Lockheed Missiles and Space Co., Palo Alto, Calif.
CRACK PROPAGATION STUDIES OF WELDS IN TANTALUM AND COLUMBIUM SHEET Final Report, 15 Jan.–22 Mar. 1967
K. E. Hays Mar. 1967 31 p refs
(8-70-67-18; AD-654150) CFSTI: HC $3.00/MF $0.65

Single pass welds were prepared in 0.015-in.-thick tantalum (Ta) and columbium (Cb) sheet material by the automatic-inert-gas, nonconsummable electrode (TIG) process, representing best practice. Edges of the material were formed to provide filler material. Tensile and precracked sheet Charpy tests were performed. Crack propagation resistance measurements were obtained for weld centerline, heat affected zone and base metal locations. Modes of failure were obtained and categorized. Both macroscopic and microscopic examinations were made of the weld zone, heat affected zone, and base metal. Author (TAB)

N67-33703# Eagle-Picher Co., Miami, Okla. Research Labs.
PURIFICATION AND CRYSTALLIZATION OF AMORPHOUS BORON POWDER. RECOVERY AND PURIFICATION OF BORON FROM RESIDUES AND SCRAP Technical Report, 1 Jul.–31 Dec. 1966
John R. Musgrave, ed., Ralph J. Starks, Harold E. Erwin, A. L. Fluesmeier, John T. Buford et al Oak Ridge, Tenn., Div. of Tech. Inform. Extension, 15 Jan. 1967 45 p
(Contract AT(40-1)-3327)
(TID-23704) CFSTI: HC $3.00/MF $0.65

A process for preparation of high-purity ^{10}B by hot-wire deposition is presented in detail. A particle-size analysis using micromesh sieves is described, which gives good reproducibility and appears to have advantages over present methods. A horizontal zone-refining method yielding good purity and recovery is summarized. Author (NSA)

N67-33712# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF STABILIZATION OF THE FOCAL SPOT IN EQUIPMENT FOR ELECTRON-BEAM WELDING [SPOSOB STABILIZIATSII FOKAL'NOGO PYATNA V USTANOVKAKH DLYA ELEKTRONNOLUCHEVOY SVARKI]
N. V. Podola, V. I. Salan, and A. B. Koval' 23 Jan. 1967 7 p Transl. into ENGLISH from Russian Patent no. 173587 (Appl. no. 867015/24-7, 23 Nov. 1963) 2 p
(FTD-HT-66-706; AD-653528) CFSTI: HC $3.00/MF $0.65

The Author Certificate introduces a method of stabilizing the focal spot in electron-beam welders with the focusing system receiving power from the network through a rectifier and a magnetic amplifier with the network-voltage and an accelerating-voltage feedback. To improve stabilization, a correcting signal proportional to the changes in accelerating voltage is fed continuously to the focusing system. Author (TAB)

N67-33784 Hermann Oberth-Gesellschaft, Gesellschaft zur Foerderung der Erforschung und Erschliessung des Weltraums E.V., Hanover (West Germany).
SYMPOSIUM ON WELDING AND ADHESION IN AEROSPACE CONSTRUCTION [UEBERSICHTSVORTRAGE: FACHTAGUNG SCHWEISSEE UND KLEBEN IM LUFT- UND RAUMFAHRZEUGBAU] Summary Reports
[1966] 35 p In GERMAN Symp. papers presented at Hanover–Messe, 1966

The present-day status of adhesion techniques and metal welding methods is reviewed in application to the construction of aircraft and spacecraft. European rocket technological developments are cited in the light of their dependence on the growing importance of aerospace construction methods. Propellant tank storage considerations for Saturn IV and Saturn IVB spacecraft are mentioned. Ample schematics and photographs accompany the technical data presented. Transl. by R.Li.

N67-33834*# Pennsylvania Univ., Philadelphia. Towne School of Civil and Mechanical Engineering.
THE ELECTRIC AUTOMOBILE—A DISCUSSION OF STRATEGY, TACTICS, AND LEADERSHIP
Manfred Altman 1967 10 p
(Grant NSG-316)
(NASA-CR-87314) CSCL 13F

An electrically powered automobile is likely to affect a substantial portion of our economy since activities related to it are increasing exponentially. Danger exists that this sudden frenzied activity may cause grave harm and waste unless it is correctly channeled. An analysis is presented of the interplay between the national segments most concerned: (1) the federal government, representing the public; (2) automobile manufacturers; (3) electric power source developers; (4) space agencies concerned with technological spin-off; (5) the academic community; (6) regional and city planners; (7) labor unions; and (8) the petroleum industry. Consideration is given to the logical sources of leadership and attempts to define the required strategy and tactics which may help minimize wasted resources and maximize the potential benefits of this technological advance. Author

N67-33846# Bettis Atomic Power Lab., Pittsburgh, Pa.
THEORY OF THE SINTERING OF WIRES BY SURFACE DIFFUSION
F. A. Nichols Jan. 1967 35 p refs Presented at the 96th Ann. Meeting of the Am. Inst. of Mining, Met., and Petrol. Engr., Los Angeles, Feb. 1967
(Contract AT(11-1)-GEN-14)
(WAPD-T-1965; CONF-670206-2) CFSTI: HC $3.00/MF $0.65

A convergent, stable, finite-difference solution has been developed for the case of two-dimensional shape changes due to capillarity-induced surface diffusion and applied specifically to the cases of an infinite line of wires and a wire on a plane. The solution for the wire on a plane shows significant deviation from the earlier, order-of-magnitude solution for a sphere on a plane. The solution for an infinite line of wires was obtained for the first time. Both cases show that a time law is only approximately obeyed in a restricted range of neck size. This, coupled with other indications, led to the conclusion that surface diffusion has been the dominant mechanism in all wire-sintering experiments to date and some of the data have been re-evaluated on this basis. The solution also provides a quantitative theoretical basis for the actual neck shapes evolved, shows them to be in agreement with the previous predictions of Mullins and in substantial disagreement with the shapes assumed in the previous order-of-magnitude treatments. Author (NSA)

N67-33913# Frankford Arsenal, Philadelphia, Pa.
A NUMERICAL TAXONOMY METHOD TO EVALUATE AND PREDICT EQUIPMENT PERFORMANCE AND ENVIRONMENTAL ENGINEERING DATA
Maurice H. Simpson Apr. 1967 64 p refs
(FA-R-1847; AD-653621) CFSTI: HC $3.00/MF $0.65

Environmental engineering seeks solutions to particularized problems about equipment compatability with natural and man-made environments. Since World War II environmental engineering has become costly, time consuming and a big consumer of lead time in product development. However, since World War II considerable environmental effects data about equipment performance has been painstakingly obtained and stored. These data are pertinent and relevant to present day equipment. It is accessible—yet, it isn't being used. The engineering community continues to design and test rather than 'search' the literature for these environmental effects data. As an element of engineering, information is meaningful only in terms of decision making, and decision making patterns related to physical systems. Raw description doesn't adequately fit this pattern, so the engineer cannot use it. Information retrieval system effectiveness is now measured by the number of hits vs misses of relevant documents retrieved. This is not enough for the engineer, he needs information, not data or some documents that might contain what he is looking for. The proposed method developed herein corrects this situation by converting the raw documental data into usable information directly applicable to the engineer's decision process in terms related to performance of physical systems. It does so by introducing into the information retrieval process a system of numerical taxonomies that are clinically diagnostic of equipment performance characteristics. These taxonomies are descriptive throughout the range from failure to oversuccess and are called 'environmental predictors.' Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-32773# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
TEMPORAL COHERENCE AND FREQUENCY VS TIME CHARACTERISTICS OF A Q-SPOILED RUBY LASER
G. J. Wolga 30 Oct. 1966 93 p refs
(Contract AF 19(628)-5677)
(SR-2; AFCRL-67-0052; AD-653213) CFSTI: HC $3.00/MF $0.65

A mode selected, cryptocyanine Q-switched ruby laser was designed, constructed, and operated. The degree of mode selectivity as a function of cryptocyanine loss was studied and an optimum loss was selected. Theoretical work was done to incorporate the cryptocyanine loss into a theory of passively Q-switched lasers. A transient interference experiment was redesigned for operation with a Q-spoiled laser. Data was obtained showing that the rate of change of the laser frequency during the Q-spoiled emission pulse is approximately twenty times the rate of change during a single spike of an ordinary ruby laser. This result tends to confirm a previously stated model for this frequency change which attributes it to direct atomic coupling to lattice strain. The ions are expected to act independently in causing the strain and hence the variation in cavity optical length is expected to be linear in the change in the number of excited states in the laser. Since the rate of change of population inversion during Q-spoiled emission is much larger than for normal lasing it was expected, prior to this work, that a greater rate of change of frequency should be observed. This has now been confirmed. Author (TAB)

N67-32812# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF APPLIED SPECTROSCOPY
23 Jan. 1967 28 refs Transl. into ENGLISH from ZH. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 2, n. 1, Jan. 1965 p 37–44, 87–89
(FTD-MT-65-144; AD-647738) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. STIMULATED RAMAN SCATTERING INSIDE THE RESONATOR OF A PRIMARY LASER B. I. Stepanov and P. A. Apanasevich p 1–16 refs (See N67-32813 19-16)

2. ON THE TECHNIQUE OF DETERMINING THE LUMINOUS EFFECTIVENESS OF ILLUMINATING SYSTEMS OF LASERS A. A. Kaminskiy and L. S. Korniyenko p 17–22 refs (See N67-32814 19-16)

N67-32813# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SIMULATED RAMAN SCATTERING INSIDE THE RESONATOR OF A PRIMARY LASER
B. I. Stepanov and O. A. Apanasevich *In its* J. of Appl. Spectroscopy 23 Jan. 1967 p 1–16 refs (See N67-32812)

A discussion is presented on the dependence of the power of Raman scattering in steady state operation in a substance placed in the resonator of a primary laser on the various parameters of the laser, and also on the properties of the scatterer and the resonator for radiation of the combination frequency. This analysis is conducted while taking into account the reverse influence of Raman scattering on the operation of the primary laser. Relationships are obtained which make it possible to determine the threshold and optimum (for development of stimulated Raman scattering) values of various parameters of the system. Author

N67-32814# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE TECHNIQUE OF DETERMINING THE LUMINOUS EFFECTIVENESS OF ILLUMINATING SYSTEMS OF LASERS
A. A. Kaminskiy and L. S. Korniyenko *In its* J. of Appl. Spectroscopy 23 Jan. 1967 p 17–26 refs

A simple method is described for experimentally determining the effectiveness of illuminating systems of lasers according to distribution of the radiation field of an excitation source on a model of a cylindrical illuminator of elliptical section. Author

N67-32883# Raytheon Co., Waltham, Mass. Research Div.
HIGH POWER GAS LASER RESEARCH Final Technical Report, 15 Mar. 1966–14 Jan. 1967
David R. Whitehouse May 1967 120 p refs
(Contract DA-01-021-AMD-12427(Z))
(S-940; AD-653031) CFSTI: HC $3.00/MF $0.65

The report concerns the investigation and optimization of high power and high efficiency in the cw gas laser utilizing carbon dioxide, nitrogen and helium as the active laser medium. In all cases, the gases are excited by an electrical discharge. In the area of flowing gas lasers, an experimental investigation was made into the unsaturated gain characteristics at 10.6 microns and their dependence on the tube diameter, gas mixing, and flow speed. The measurements were taken with a laser bridge of sufficient resolution to measure the radial profiles of the gain. For the high-power oscillators, determination was made of the dependence of the power on tube length, gas pressure, pumping speed, output coupling, and mode control. For sealed-off lasers, determination was made of the dependence of the output power on the gas mix, pressure, and tube preparation. Some results on the initial phases

of long life tests are also included. Much of the data which was accumulated indicates that the present limitations of output power in large bore tubes and sealed-off tubes stem from the heating of the gas by the discharge. This is corroborated by theoretical calculations of the heat transfer and temperature profile in the tube. Author (TAB)

N67-32979# General Dynamics/Electronics, Rochester, N. Y. Electronics Div.
OPTICAL INTERACTIONS IN RUBY LASERS Final Report, 1 Dec. 1965–31 Nov. 1966
Fred C. Unterleitner and Ying C. Kiang 28 Feb. 1967 70 p refs
(Contract AF 19(628)-5810)
(AFCRL-67-0194; AD-653218) CFSTI: HC $3.00/MF $0.65

The report concerns the initial stages of an investigation into the efficiency of ruby lasers, and the kinetics of energy level populations generated by optical pumping. The work described includes the calibration of absolute spectral response of photodetectors, the measurement of ground state absorption cross sections, and the metastable state absorption cross section at selected wavelengths; also described are the preliminary experiments involving end pumping by ion laser radiation at 5682 A. Efficiency measurements at high metastable state populations could not be made with the ion laser power levels available. Calculations based on the absorption measurements, however, indicate a strong wavelength and polarization dependence of overall pumping efficiency in ruby lasers, with metastable state absorption playing an important role in heat input to ruby during pumping. The effectiveness of high pressure mercury discharges for cw pumping is clarified by this analysis. Author (TAB)

N67-33034# Minnesota Univ., Duluth. Electrical Engineering Dept.
ACTIVE DISTORTION DURING RUBY LASER ACTION
Mylan Radulovich and R. J. Collins Apr. 1967 58 p refs
(Contract Nonr-710-(61))
(TR-5; AD-653060) CFSTI: HC $3.00/MF $0.65

Ruby laser rods were studied with respect to thermal distortions induced by the excitation pump flash. Nonuniform temperature distributions cause optical distortions and prevent the laser beam from realizing its minimum theoretical width (diffraction limit). These variations result from the radial distribution of absorbed energy. The radial gradients produce changes in the index of refraction and optical path length which lead to a lens type behavior by the ruby rod. More uniform pumping would reduce the temperature distributions and consequently diminish this lens effect. Author (TAB)

N67-33044# Hughes Research Labs., Malibu, Calif.
STUDY OF FUNDAMENTAL REQUIREMENTS FOR HIGH BRIGHTNESS RAMAN LASER SOURCES Semiannual Technical Summary Report, 1 Oct. 1966–31 Mar. 1967
F. J. McClung May 1967 27 p refs
(Contract NO0014-67-0206; Proj. Defender)
(AD-653108) CFSTI: HC $3.00/MF $0.65

The study is of SRS in liquids. The production of high brightness Raman devices is possible in liquids; however, the brightness gain over existing laser devices does not appear to be very large. We must exercise care in selection of the material to achieve any semblance of gain. The case for gases is much better. Many unexplained processes occur in H_2 and possibly other gases as well. The brightness gains that could be produced have not yet been determined, and the main effort is now concentrated on this problem. We are also investigating the strange behavior of H_2 in the usual SRS experiments. Author (TAB)

N67-33106# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass.
STUDIES FOR A GEODETIC LASER SYSTEM Final Report, 1 Jul. 1965–30 Apr. 1967
Sumner Ackerman 1 May 1967 28 p refs
(Contract AF 19(628)-5516)
(B-3546; AFCRL-67-0229; AD-652235) CFSTI: HC $3.00/MF $0.65

This report contains a brief summary of photoelectric (range) detection, photographic (direction) detection, and design studies made for a geodetic laser system. It appears feasible to measure the displacement between a ground-based (ruby) laser system and a satellite equipped with retrodirective reflector arrays (such as those on the Explorer and Geos satellites) to an accuracy of 2 arc-seconds in direction and less than 10 meters in range at slant ranges of over 2000 km, using essentially state-of-the-art equipment described herein and in the references. The probability of detection is expected to be greater than 90% without optical tracking, if the direction is known in advance to within approximately 2 arc-minutes and the range to within approximately 1 km. Author (TAB)

N67-33284# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.
AMOUNT OF MATTER EMITTED AS A JET FROM A LASER IRRADIATED PELLET
P. Giupponi and R. Gratton Mar. 1967 7 p refs Sponsored in part by EURATOM
(LGI-67-7) CFSTI: HC $3.00/MF $0.65

This paper is an attempt to evaluate what fraction of plasma is emitted in the form of a hypersonic jet when a small solid target is vaporized by a large-pulse, and what fraction expands isotropically. Author (ESRO)

N67-33365*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MASER RESEARCH PROGRAM
A. W. Nagy *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Materials preparation and microwave bench measurements are reported for a zero-field traveling wave (TW) maser, for which two fluxed-melt runs were completed with 0.08% iron concentration containing 0.25% and 0.50% lanthanum oxide for modifying crystal growth habit. The second run with charges dry mixed was successful, and confirmed the deleterious effect of too much lanthanum oxide for the slower cooling rates. While crystal quality was no better than for the usual 4°C/hr rates, there were fewer flux inclusions between the crystal planes. Iron-doped alumina rods were prepared to determine optimum iron concentration for the TW maser structure, and the first helium run on the zero-field TW maser was completed following extended bench adjustments to secure reasonably good input and output impedances to the helix. M.W.R.

N67-33484# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RAY PENETRATING INTO THE FUTURE ULTRADISTANT COSMIC COMMUNICATION LIGHT PULSES OF SATELLITES
N. Aleksandrov 21 Feb. 1967 13 p Transl. into ENGLISH from Nauchno-Tekhn. Obshch. SSSR (USSR), no. 8, 1964 p 41–43
(FTD-HT-66-439; TT-67-62146; AD-653962) CFSTI: HC $3.00/MF $0.65

The Lenin Prize for 1964 was presented to Associate Member of the AN SSSR Bentsion Vul and a large group of coworkers for the development of a gallium-arsenide semiconductor laser. The

semiconductor laser is almost 100% efficient and its microminiature size holds great promise for use in computers to achieve speeds of tens of billions of operations per second. Direct communication over distances of several light years is considered possible with the use of lasers. Satellites carrying a laser could be easily seen and accurately tracked both day and night. Applications of lasers in radio, telephone and television communications and in chemistry are mentioned. Quantum techniques make possible a construction of clocks accurate to one second in ten thousand years which could be used to conduct relativity experiments. Use of the laser beam as a metal working and surgical tool is mentioned. Long distance, high-efficiency transmission of energy by laser beam, especially in space where the absorbing and scattering effects of the atmosphere are avoided, is considered absolutely essential in the conquest of space. Direct conversion of matter into energy without explosion is possible using quantum devices. Quantum engines may utilize solar energy during space flight. Author (TAB)

N67-33618* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
QUANTUM ELECTRONICS AND MILLIMETER WAVES
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 243–244 refs (See N67-33593 19-10)

Quantum electronics engineering developments are recapitulated in connection with a study of millimeter waves. A mathematical description is provided for an evaluation of resonant mixing and parametric oscillations at optimal frequencies. R.U.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-32803# Frankford Arsenal, Philadelphia, Pa.
COUNTER-GRAVITY CASTING OF ALUMINUM ALLOYS IN GREEN SAND MOLDS
Fred Ripkin and Samuel Lipson Feb. 1967 39 p refs
(FA-R-1836; AD-653148) CFSTI: HC $3.00/MF $0.65

An apparatus for counter-gravity pouring of aluminum alloys into sand molds has been designed and its operation demonstrated. It was shown that such parameters as flow rate, casting pressure, and pouring temperature can be closely controlled. The upward flow of metal into the mold is caused by movement of a rubber diaphragm; air pressure under the diaphragm forces a sand bed to rise and the liquid metal resting on the sand is thus lifted into the mold. It was found that under controlled pouring conditions, generally higher tensile strengths and markedly greater ductility can be obtained with cast-to-size 0.505 in tensile test bars than is possible with conventional gravity practices. Markedly improved mechanical properties were also realized by counter-gravity casting of a mortar base plate as compared to properties obtained with the same casting procured from commercial sources. Turbulent flow conditions resulting from excessively high flow rates severely degraded the properties of the cast material even when the counter-gravity practices were employed. In another test casting (a finned aluminum alloy 142 cylinder head), it was shown that misruns in the fin areas could be reliably eliminated through controlled counter-gravity pouring. Fluidity tests were also conducted to demonstrate the effect of various pouring parameters on the length of a fluidity spiral. Author (TAB)

N67-32816*# Teledyne Materials Research Co., Waltham, Mass.
EVALUATION OF THE EFFECT OF COLD WORK ON DISPERSION-STRENGTHENED NICKEL-BASE ALLOYS
Summary Report, 13 Jun.–13 Dec. 1966
R. C. Nelson and R. Widmer Apr. 1967 54 p refs
(Contract NAS3-7265)
(NASA-CR-72240) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An evaluation of the effect of cold work on nickel alloys containing thorium dioxide was undertaken. Drawing and swaging techniques were used to introduce the cold work to these 80% nickel/20% chromium-base alloys. Swaging was performed with 10%, 15% and 20% reductions of area per cycle. Intermediate anneals at 1600°F and 2000°F were used to complete the working cycle. Sound material was obtained after extensive amounts of working. Elevated temperature tensile strengths were generally improved by introducing cold work. Author

N67-32844# Frankford Arsenal, Philadelphia, Pa. Fire Control Development and Engineering Labs.
ELECTROMAGNETIC INSPECTION OF HARDENED STEEL
Theodore A. Cox Apr. 1967 63 p refs
(FA-M67-24-1; AD-653007) CFSTI: HC $3.00/MF $0.65

A program was undertaken to investigate the use of eddy current test techniques for: (1) The measurement of case depth on steel parts processed by heat treat methods (no carbon added to the surface), and (2) The determination of through hardness or tempering temperature history of Stentor tool steel and 4340 steel parts. Eddy current tests showed that the relationship of case depth to eddy current output had insignificant correlation. The effects of case depth variation appeared to be obscured by the effects of other material variations such as hardness and grain structure. The effectiveness of phase sensitive and harmonic eddy current test methods for determining tempering temperature history of 4340 and Stentor tool steels was evaluated by performing numerous tests on specially prepared specimens. Eddy current tests utilizing third harmonics of the probe energizing frequency showed that tempering temperature history of 4340 and Stentor steel can be determined for all temperatures (265 F to 820 F) used for specimen preparation on this program. TAB

N67-32858# Army Materials Research Agency, Watertown, Mass.
A REPORT GUIDE TO FATIGUE TESTING LITERATURE
Charles P. Merhia May 1967 69 p refs
(AMRA-MS-67-05; AD-652881) CFSTI: HC $3.00/MF $0.65

The main objective of the compilation is to provide simple and fast access to information on the subject of fatigue testing and yet provide sufficient information in the form of abstracts and word descriptors to make the listing useful. TAB

N67-32909# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS
Technical Progress Report, Mar. 1, 1966–Mar. 1, 1967
A. A. Hendrickson, B. C. Peters, and R. H. Hammar 1 Mar. 1967 24 p refs
(Contract AT(11-1)-916)
(TID-23747; TPR-7) CFSTI: HC $3.00/MF $0.65

Developments in studies on the causes of solid solution strengthening effects in bcc and fcc metal solutions were investigated. Studies on the fcc solid solutions of Ag consisted of: effects of Sn and In additions on dislocation density and strength of Ag crystals; and preparation of Ag crystals of very low dislocation density for dislocation velocity studies. Research on Nb-base bcc solid solutions was in three areas: effects of substitutional alloying elements on the stress–strain behavior of Nb; effects of Mo and

Ta additions on the athermal strength of Nb; and the effects of Mo and Ta additions on the thermally activated deformation of Nb. NSA

N67-32914# Nuclear Materials and Equipment Corp., Apollo, Pa.
GROWTH OF SINGLE CRYSTALS OF PLUTONIUM Progress Report, Oct. 1–Dec. 31, 1966
Mar. 1967 18 p refs
(Contract AT(30-1)-3428)
(NUMEC-3428-29) CFSTI: HC $3.00/MF $0.65

Large grains of α Pu (≈0.75 mm average diameter) were grown using a variety of experimental conditions. All of the high pressure runs in this series were done at a temperature of 425°C using four hour holding times. This series of experiments completes a parametric study concerning the effects of varying cooling rates, pressure, and temperature of high pressure release prior to cooling with respect to the observed α Pu microstructure. The isothermal transformation of experimentally melted and solidified β Pu for 800 hours at 106.5±0.5°C resulted in a highly sub-grained α Pu microstructure which exhibited a three volume percent dispersion of voids. The density of the α Pu decreased by 0.68 g/cm^3 from the original as-cast density of 19.55 g/cm^3. The resulting α Pu microstructure had an average grain size of 0.3 mm. Author (NSA)

N67-32919# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
EFFECTS OF DEIONIZED WATER IMMERSION OF PREPARED ALUMINUM SURFACES ON ADHESIVE BONDABILITY
Raymond F. Wegman, William M. Bodnar, Michael J. Bodnar, and Modesto J. Barberisi May 1967 28 p refs
(TR-3495; AD-652358) CFSTI: HC $3.00/MF $0.65

The effects of immersion in deionized water and in tap water on the bondability of 2024 aluminum which had been surface-treated with sulfuric acid-sodium dichromate solution were compared. Substantial losses in bond strengths were experienced with aluminum that had been immersed in deionized water. Poor bonding surfaces were readily identifiable from the formation of an iridescent coating which further investigation revealed to be related to the thickness of the hydrate layer formed. Addition of certain multivalent compounds to the deionized water was found to affect the formation of the hydrate layer and subsequently to increase the bond strengths. Author (TAB)

N67-32990# IIT Research Inst., Chicago, Ill. Dept. of Metallurgical Engineering.
ON THE EXISTENCE OF CUBIC IRON–CARBON MARTENSITE
N. N. Breyer and E. S. Nachtman (La Salle Steel Co.) Dec. 1966 27 p refs
(Contract DA-31-124-ARO(D)-420)
(TR-1; AROD-5533; 1-MC; AD-651991) CFSTI: HC $3.00/MF $0.65

AISI 4340 steel bars in the untempered martensitic condition were reduced various amounts up to 10% by drawing. Specimens machined from each bar were examined with x-ray diffraction intensity measurements for two face orientations. It was confirmed that for a specimen face orientation perpendicular to the die drawing direction the integrated intensity increased with increasing deformation. In sharp contrast with this effect, it was found that for a specimen face orientation inclined 45 degrees to the die drawing direction the integrated intensity decreased slightly with increasing deformation. The x-ray intensity data was reconciled by using the model based on the following points: (a) the as-quenched 0.40 carbon martensite is cubic after a very short time at room temperature. (b) the deformation introduces dislocation networks on active 110 slip planes. (c) Eshelby locking in the stress fields of the dislocations results in tetragonal martensite regions. (d) The ordering to form tetragonal martensite causes an increase or decrease in the x-ray diffraction intensity depending upon the orientation of the specimen face being examined. Author (TAB)

N67-32997# Avco-Everett Research Lab., Everett, Mass.
PERFORMANCE OF STABILIZED Nb-40% Ti IN A HIGH CURRENT DENSITY 50 KG SUPERCONDUCTING SOLENOID
A. E. Binderi, R. E. Bernert, and L. O. Hoppie May 1967 17 p refs
(Avco-Everett Res. Rept.-270)

A Nb-40% Ti alloy was successfully stabilized using OFHC copper as a stabilizing substrate. The composite superconducting material was 0.020" O. D. copper-clad wire containing .011" core of Nb-40% Ti. The method of production, the heat treatment to optimize the H-I characteristics of the alloy, and the mechanical properties are reported. The stabilization characteristics of the short sample are briefly discussed. The construction and the successful performance of a high overall current density (≈2×10^4 amps/cm^2) superconducting solenoid producing ≈50 kG in a 2-3/4-inch bore using Nb-40% Ti are fully discussed. Author

N67-32999# Materials Research Lab., Inc., Richton Park, Ill.
DEVELOPMENT OF TEST PROCEDURES. FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSEL STEELS. NOVEMBER 1, 1966–JANUARY 31, 1967
E. J. Ripling and P. B. Crosley 24 Mar. 1967 12 p ref
(Contract AT(11-1)-1477)
(COO-1477-7) CFSTI: HC $3.00/MF $0.65

Design features for evaluation of irradiation damage in terms of fracture toughness are described. With double cantilever beam (DCB) specimens contoured to m=3 with b=1.00 and b_n/b=0.75 a single test, which would normally be inconclusive because of a failure to obtain valid plane strain fracture, can define a value of K_{Ic} which underestimates the plane strain fracture toughness of the material. Its practical significance requires that this lower limit of K_{Ic} occur at a realistic toughness level and/or that there be some satisfactory method of estimating the extent to which the toughness is underestimated. Measurements of K_{Ic} up to about 100 ksi in.^{2} were obtained. This value is greater than the room temperature fracture toughness for the weakest orientation, but less than the toughness for other orientations. NSA

N67-33035# Lehigh Univ., Bethlehem, Pa.
MECHANICAL PROPERTIES OF A HIGH-MANGANESE, LOW-CARBON STEEL FOR WELDED HEAVY-SECTION SHIP PLATE Progress Report
R. D. Stout and C. R. Roper, Jr. Aug. 1966 27 p refs
(Contract Nobs-84829)
(SSC-175; PR-2; AD-637211) CFSTI: HC $3.00/MF $0.65

A study was made of the mechanical properties and weldability of a steel composition which was judged to show promise as a steel for heavy-section ship plate. The steel was chosen on the premise that a simple carbon–manganese steel could be heat-treated to furnish the desired properties including weldability at a lower cost than that of more complex alloy steel grades. Broadly, the steel in thicknesses up to 3 inches was expected to possess the strength, resistance to brittle fracture, and weldability equal to 2-inch normalized ABS Class C steel. While the laboratory tests could not be used to determine the service properties of the steel, they provided a direct comparison of the steel to ABS Class C, whose characteristics and service performance are well-known. TAB

N67-33049# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.

EXTRUDABILITY VS. GRAIN STRUCTURE OF NORMAL URANIUM, SUMMARY

C. A. Scharschu *In its* [Mark V-B Process Improvement, NPR Process Improvement, Basic Extrusion Tech.] 10 Oct. 1966 48 p refs (See N67-33048 19-15)

(Rept.-4)

A series of experiments were conducted to determine the influence of billet preheat temperature, ram speed, die approach angle, and reduction ratio on both extrusion pressures and developed grain structures. Summary data presented on the results indicate: (1) Pressure and grain structure response are characteristic of the metal temperature at the time of extrusion, i.e., the energy state at the time of extrusion is the controlling factor regardless of the route by which this state is reached. (2) An increment of ram speed can be equated to an increment of heat. (3) Upset pressure varies with time of upset, billet temperature, and reduction ratio. (4) Below the critical heat energy level, coarse grain decreases in the direction of increasing uniformity of metal flow through the seat of deformation. M.G.J.

N67-33103# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

X-RAY INVESTIGATION OF SURFACE LAYER OF CERTAIN HEAT-RESISTING ALLOYS AFTER HEAT TREATMENT IN VARIOUS GAS MEDIA

V. V. Zhukov and A. A. Nilov *In its* Trans. of the Kazan Aviation Inst., No. 66 22 Mar. 1967 p 13–18 refs (See N67-33101 19-33)

The results of an X-ray investigation of two heat resistant alloys (EI437B and EI617) after heat treatment in atmospheres of air, nitrogen, nitrogen with 10% hydrogen, and argon are reported. Microhardness of the samples was determined with a PMT-3 instrument under a 200-gram load. Samples were X-rayed with a URS-70 apparatus in a focusing chamber. Curves constructed on the basis of the X-ray investigation and the microhardness test indicated satisfactory agreement with the experimental results. The experiments proved that a nitrogen–hydrogen atmosphere has good protective properties, and is inferior only to an argon atmosphere. The application of this protective atmosphere may make it possible to decrease the depth of the defective layer produced by hot working of billets. Author

N67-33201# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

CORROSION OF SUPERALLOYS AND REFRACTORY METALS IN HIGH TEMPERATURE FLOWING HELIUM

L. A. Charlot, R. A. Thiede, and R. E. Westerman Mar. 1967 28 p refs

(Contract AT(45-1)-1830)

(BNWL-SA-1137) CFSTI: HC $3.00/MF $0.65

The oxidation and evaporation behavior of Hanes 25 and Hastelloy X was determined under flowing He conditions in two high temperature loop systems at temperatures to 2100°F, linear flow velocities to 500 fps, and pressure of 200 psi. Oxidation rates of the superalloys did not appear to be affected by the presence of high-velocity He. Evaporation rates increased with gas flow rate and temperature, and decreased with inert gas overpressure. Refractory metal samples were exposed along with superalloy samples in the larger loop at 2100°F, 300 psi. It was found that clean loop conditions, with multiple start-ups after permitting access of air to the loop system, led to evaporative weight loss of the superalloys, contamination and weight gain of the Nb and Ta samples, and no significant evidence of attack on the Mo and W samples. Author (NSA)

N67-33202# Oak Ridge National Lab., Tenn.

RADIATION METALLURGY SECTION, SOLID STATE DIVISION Progress Report, Period Ending Jan. 1967

D. S. Billington and M. S. Wechsler Apr. 1967 53 p refs

(Contract W-7405-ENG-26)

(ORNL-4097) CFSTI: HC $3.00/MF $0.65

Studies on the radiation embrittlement of weld heat-affected-zone samples and base plate of ASTM A-212B pressure-vessel steel showed the effects of irradiation temperature on the shift of ductile brittle transition temperature of base plate and HAZ specimens. Heat to heat variations of sensitivity to radiation embrittlement were quite striking. Studies of the increase of yield stress of ferrovac-E iron samples irradiated to the same dose but at different rates have now been completed. No effect of dose rate on yield stress increase was observed for dose rates ranging from about 1.7×10^{11} neutrons/cm^2 sec to 2.3×10^{13} neutrons/cm^2 sec (E>1 MeV). Studies of annealing of radiation hardening were carried out in the temperature range from 300° to 400°C. It was observed that the radiation damage became more stable with increasing dose in the interval 4×10^{17} to 5×10^{18} neutrons/cm^2 (E>1 MeV). Studies were also carried out which indicate an effect of interstitial impurities in producing radiation hardening. The temperature and strain rate dependence of the flow stress of irradiated polycrystalline iron specimens was tested. The activation volume was not changed by irradiation while the activation energy was increased by irradiation. A niobium single crystal with a total impurity content of <75 ppM and a resistivity ratio R 300/R 4.2=1420 was produced. An annealing procedure for improving the perfection of niobium single crystals was determined and X-ray topographs of the resulting crystals were made. Studies of dislocation motion in niobium single crystals using etch pits were continued and procedures for decorating dislocations in very high purity niobium were determined. Stage II annealing in irradiated niobium was studied using internal friction and resistivity measurements. The results showed that Stage III annealing is due to migration of oxygen atoms to radiation produced defects. NSA

N67-33214# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

JOURNAL OF PHYSICS, VOLUME 20, NO. 1 Selected Articles

31 May 1966 53 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 20, no. 1, 1964 p 41–54, 72–82

(FTD-TT-65-1051; TT-66-62247; AD-638976) CFSTI: HC $3.00/MF $0.65

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2. INTERNAL FRICTION PEAKS ASSOCIATED WITH THE COHERENCY OF THE DECOMPOSITION PRODUCTS OF HIGH-CARBON AND LOW-CARBON MARTENSITES Y.-i. Ma and T.-s. Ke' p 29–49 (See N67-33216 19-17)

N67-33216# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTERNAL FRICTION PEAKS ASSOCIATED WITH THE COHERENCY OF THE DECOMPOSITION PRODUCTS OF HIGH-CARBON AND LOW-CARBON MARTENSITES

Ying-liang Ma and Ting-sui Ke *In its* J. of Phys., Vol. 20, No. 1 31 May 1966 p 29–49 (See N67-33214 19-17)

Previous studies showed that internal friction peaks appeared in the process of tempering high carbon and low carbon martensites at around 130°C and 150°C, respectively. Based on the conditions

associated with the appearance and disappearance of the peaks, this paper makes a more systematic study of the tempering of high carbon and low carbon martensites and the formation and destruction of the coherent decomposition products. Experimental results indicated that in the case of high carbon as well as low carbon martensite, the position of the internal friction peaks (when expressed as a function of temperature) did not change with a change in the frequency used in measuring, but the height of the peak increased with a rise in stress amplitude. This showed that the observed internal friction peaks did not originate from a relaxation process. This could be a characteristic common to all internal friction peaks. Based on this point, it is assumed that the peaks are associated with the stress-induced movement of the coherent boundaries. An explanation of the mechanism of the production of internal friction peaks is also proposed. Author

N67-33222# Los Alamos Scientific Lab., N. Mex.
THE SHEAR STRENGTH OF SOFT-SOLDERED BRASS JOINTS AS A FUNCTION OF AGE AND TEMPERATURE HISTORY
D. H. Liebenberg 2 May 1967 7 p refs
(Contract W-7405-ENG-36)
(LA-3658) CFSTI: HC $3.00/MF $0.65

The ultimate shear strength of overlapped joints of 60 tin-40 lead solder on brass was measured under various conditions. The effect of age up to 330 days after soldering is reported. The effect on ultimate shear strength at room temperature of from 1 to 10 cycles to 77° and 20.5°K is measured for some samples, and some evidence is found for low temperature discontinuous yielding. Author (NSA)

N67-33226 Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
INTERNAL FRICTION IN IRON–ALUMINIUM ALLOYS HAVING A HIGH ALUMINIUM CONTENT [ETUDE DU FROTTENMENT INTERIEUR D'ALLIAGES FER–ALUMINIUM A FORTE TENEUR EN ALUMINIUM]
Jacques Hillairet, Jean Delaplace, and Alain Silvent 1966 35 p refs In FRENCH; ENGLISH summary
(CEA-R-2954)

By using a torsion pendulum to measure the internal friction of iron–aluminium alloys containing between 25 and 50 atom % of aluminium, it has been possible to show the existence of three damping peaks due to interstitial carbon. Their evolution is followed as a function of the carbon content, of the thermal treatment and of the aluminium content. A model based on the preferential occupation of tetrahedric sites is proposed as an interpretation of the results. A study of the ZENER peak in these substitution alloys shows also that a part of the short distance disorder existing at high temperatures can be preserved by quenching. Author

N67-33228# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
STUDY OF ALLOTROPIC TRANSFORMATIONS IN PLUTONIUM [ETUDE DES TRANSFORMATIONS ALLOTROPIQUES DU PLUTONIUM]
Bernard Spriet (Ph.D. Thesis—Paris Univ., Orsay, France) Jun. 1966 82 p refs In FRENCH; ENGLISH summary
(CEA-R-3062)

The allotropic transformations in plutonium have been studied by different methods: metallography, dilatometry, thermal analysis, resistivity measurements, examination with a hot stage microscope. In order to study the importance of the purity, purification process such as zone-melting or electrodiffusion have been developed. The characteristics of the $\alpha \rightleftarrows \beta$ transformation can be explained in terms of the influence of internal stresses on the transition temperature and on the transformation kinetics. Some particular characteristics of $\delta \rightarrow \gamma$, $\gamma \rightarrow \alpha$, $\delta \rightleftarrows \varepsilon$, $\beta \rightleftarrows \gamma$ and $\delta \rightarrow \alpha$ transformations are also given. Author

N67-33267# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
STUDY OF EFFECT OF PRESSURE ON THE Ag–Cu BINARY PHASE DIAGRAM [ETUDE DE L'INFLUENCE DES HAUTES SUR LE DIAGRAMME BINAIRE ARGENT-CUIVRE]
Guy Laloup (M.S. Thesis) Oct. 1966 93 p refs In FRENCH; ENGLISH summary
(CEA-R-3087)

The effect of pressure on melting points of silver and copper as well as eutectic point was investigated up to 60 kbar in a solid medium inside a belt type apparatus. Melting and solidification points were detected by thermal and differential thermal analysis. Solubilities and concentrations were studied by micrographic analysis and Castaing electron microprobe technique. At 50 kbar, the eutectic reaction's characteristics are: $T_E = 916 \pm 10°C$, $c_E = 33 \pm 1$ wt% Cu, $c_\alpha = 14 \pm 1$ wt% Cu, $c_\beta = 84 \pm 1$ wt% Cu, and melting points of pure silver and pure copper increase respectively of $170 \pm 10°C$ and $133 \pm 10°C$. Solid solubility of silver and copper increase appreciably. Author

N67-33280# Commissariat a l'Energie Atomique, Saclay (France). Centre D'Etudes Nucléaires.
CONTRIBUTION TO THE STUDY OF THE SINTERING OF EX-CARBONYL IRON IN THE α AND γ PHASES USING THE MICROFRACTOGRAPHICAL TECHNIQUE [CONTRIBUTION A L'ETUDE DU FRITTAGE DU FER EX-CARBONYLE EN PHASE α ET γ PAR EXAMEN DES SURFACES DE RUPTURE AU MICROSCOPE ELECTRONIQUE]
Marie-Thérèse Oxley (Ph.D. Thesis—Paris Univ.) 1966 57 p refs In FRENCH; ENGLISH summary
(CEA-R-2998) CFSTI: HC $3.00/MF $0.65

The microfractographical study of the sintering of ex-carbonyl iron has shown or confirmed a number of phenomena of which the principal are as follows: Sintering in the α phase: a) existence of two stages of sintering differentiated by the type of rupture (inter or transcrystalline); b) marked influence of the content of oxygen in the atmosphere and in the initial compressed sample on the speed of sintering; c) formation of striations on the grain-boundary surfaces and on the inner surfaces of pores caused by the presence of oxygen. Sintering in the γ phase: a pronounced decrease in the speed of sintering (the grains in the initial powder remain in the granular state within the final α crystal in the iron sintered in the lower γ range even after several hrs of sintering). Other phenomena are also noted. The results of the study agree with micrographic investigation as well as with dilatometric measurements and known autodiffusion coefficients. Author

N67-33287*# National Aeronautics and Space Administration, Washington, D. C.
FRITTING OF REFRACTORY MATERIALS [FRITTAGE DE MATERIAUX REFRACTAIRES]
A. Hivert Aug. 1967 3 p Transl. into ENGLISH from the FRENCH Presented at the Sci. Sessions of ONERA, Chatillon-sous-Bagneux, 23–25 Jun. 1966
(NASA-TT-F-11174) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A high temperature tensile testing machine with accurate recording of the stress–strain diagram, to determine the mechanical resistance of sintered refractory carbides of Groups IV and V transition metals, is described. Standard specimens of 30% residual porosity, prepared by sintering finely divided powders of tantalum, titanium, or zirconium carbide, were used. The tensile strength va-

temperature curve was located below the polycrystalline graphite curve for titanium and zirconium carbide, while it was above this curve for tantalum carbide, at all temperatures from room temperature to 3200°C. The high sensitivity to thermal shock of tantalum carbide is overcome by infiltration of porous skeletons with copper or silver, imparting resistance to thermal fluxes of 2000 w/cm^2 to the material and making it suitable for high temperature applications. Author

N67-33423# Franklin Inst., Philadelphia, Pa. Research Labs.
THE MICROSTRAIN REGION IN HIGH-PURITY REFRACTORY METALS Final Report, 1 Mar. 1964–28 Feb. 1967
H. L. Prekel, A. Lawley, J. D. Meakin, and H. Conrad Apr. 1967 64 p refs
(Contract Nonr-4434(00))
(F-82195; AD-651761) CFSTI: HC $3.00/MF $0.65

The behavior of dislocations in single crystals of high purity molybdenum has been inferred from dynamics tests conducted in the micro and macrostrain regions and studied more directly by making dislocation velocity measurements. All the observations can be shown to be self consistent on the basis that dislocation mobility is controlled by the overcoming of Peierls–Nabarro hills by the nucleation of double kinks. The presence of internal elastic stresses is responsible for reversible anelastic stress–strain behavior in the microstrain region extending up to strains of the order 0.001. The magnitude of the effective stress τ throughout the stress–strain curve was measured and its effect on the controlling deformation process is analyzed. Related investigations of the production and structure of extra-high purity molybdenum. The reliable etch pitting of dislocations and the defect structure of deformed and quenched molybdenum are also described. Author (TAB)

N67-33424# Franklin Inst., Philadelphia, Pa. Research Labs.
DETERMINATION OF τ^* FROM HYSTERESIS LOOPS OBTAINED IN MICROSTRAIN TESTS
H. L. Prekel and H. Conrad *In its* The Microstrain Reg. in High-Purity Refractory Metals Apr. 1967 20 p refs (See N67-33423 19-17)

A loop for stresses less than the anelastic limit during a load–unload cycle in the microstrain region was obtained, and the stress–strain behavior is discussed. Expressions are developed for the energy loss around the loop. Methods are indicated which can be used to determine the effective stress from hysteresis loop experiments. N.E.N.

N67-33527# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
FURTHER APPLICATIONS OF THE THEORY OF PARTICLE COARSENING
A. J. Ardell Feb. 1967 14 p refs
(Contract AT(04-3)-221)
(CALT-221-29) CFSTI: HC $3.00/MF $0.65

Concentration changes during coarsening, which occurs only by the diffusion-controlled transfer of solute in the matrix, were studied. The results were used to derive quantitative information about the particle-matrix interfacial free energy in well-behaved systems, whic is exemplified by data for coarsening of γ' in Ni–Ti alloys. NSA

N67-33565*# Teledyne, Inc., Alexandria, Va.
THE DEVELOPMENT OF DISPERSION-STRENGTHENED NICKEL-MOLYBDENUM NON-OXIDATION-RESISTANT ALLOYS Summary Report
R. C. Nelson and R. Widmer Apr. 1967 95 p refs
(Contract NAS3-7265)
(NASA-CR-54502) CSCL 11F

The development of a nickel/molybdenum-base alloy having a 3000-hour stress rupture strength of 15,000 psi at 2000°F was undertaken. It was expected that a fine dispersion of thorium dioxide and aluminum oxide would increase the strength of the matrix alloy to this level. Processing parameters for the preparation of such an alloy were investigated. Seven alloys including one which contained no dispersoid were prepared by selective reduction of oxides. The matrix was 85% nickel–15% molybdenum and 2, 5 and 7.5 v/o alumina or thoria was added. Fine nickel and molybdenum oxides were used as precursors for the matrix metal. The dispersed phase was introduced by mechanical mixing for alumina and by thermal decomposition of nitrates for thoria. These alloys were extruded and their structures were evaluated by optical and electron microscopy techniques before and after stability tests at 2000°F in vacuum. Three materials were selected for the evaluation of high temperature stress rupture properties. The three alloys contained 2 v/o or 5 v/o thorium dioxide or 2 v/o aluminum oxide. All stress rupture tests were conducted at 2000°F in an argon atmosphere. The stresses for the 3000-hour lives of these alloys were 600, 1000 and 450 psi, respectively. Author

N67-33575# Naval Research Lab., Washington, D. C.
STRESS-CORROSION CRACKING RESISTANCE OF AN Ni 200 GRADE MARAGING STEEL BASE PLATE AND WELD
G. Sandoz and R. L. Newbegin Mar. 1967 13 p ref
(NRL-MEMO-1772; AD-654161) CFSTI: HC $3.00/MF $0.65

The stress-corrosion cracking resistance in salt water of a welded 18Ni 200 grade maraging steel weldment was investigated. Unexpectedly, the weld metal was found to be more resistant to stress-corrosion cracking than the base plates. Author (TAB)

N67-33586 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR INSTITUTE OF METALLURGY
20 Mar. 1967 22 p refs Transl. into ENGLISH from Tr. Inst. Met. Akad. Nauk SSSR (Moscow), no. 2, 1964 p 155–160, 208–211
(FTD-MT-65-445; AD-652472)

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N67-33587 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TERNARY ALLOYS OF RHENIUM WITH TUNGSTEN AND MOLYBDENUM
K. B. Povarova, M. A. Tylkina, and Ye. M. Savitskiy *In its* Acad. of Sci. of the USSR Inst. of Met. 20 Mar. 1967 p 1–9 refs (See N67-33586 19-17)

Optimum compositions of ternary alloys of rhenium with tungsten and molybdenum are developed. It was found that with increase of rhenium content in alloys with constant ratios of tungsten and molybdenum, plastic and strength characteristics are improved. Mechanical properties of alloys were investigated on 70–75g ingots smelted in an arc furnace with a nonconsumable tungsten electrode in an atmosphere of purified argon. The changes

in hardness and in grain size, and also certain characteristic microstructures of ternary alloys after recrystallization annealing are shown in figures and investigated. The temperature of transition from plastic to brittle state is discussed. Author

N67-33588 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALLOYING THE METAL OF MOLYBDENUM WELDS WITH RHENIUM
V. V. D'yachenko and B. P. Morozov *In its* Acad. of Sci. of the USSR Inst. of Met. 20 Mar. 1967 p 11–15 refs (See N67-33586 19-17)

This article discusses alloying of molybdenum welds with rhenium in order to increase their plastic properties. Methods of welding, type of material used, type of filler material, and welding conditions were discussed. Results of microstructural analysis, change of hardness, and strength and plastic properties are brought out. Author

N67-33680# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
PRELIMINARY STUDIES OF VANADIUM-BASE ALLOYS INTENDED FOR USE IN FABRICATION OF CANS FOR FAST REACTORS [ETUDES PRELIMINAIRES SUR LES ALLIAGES A BASE DE VANADIUM ENVISAGES POUR LA FABRICATION DE GAINES DE REACTEURS RAPIDES]
Madeleine Conte Mar. 1967 65 p refs In FRENCH
(CEA-R-3152; EUR-3420.f)

Preliminary research has been carried out on a series of V-based alloys: V–0.5% Si; V–5% Ca; V–5% Mo; V–5% Nb; V–2% Zr; V–20% Ti; V–10% Al; V–10% Sn; and V–10% Ti for use as canning material in fast reactors. Transformation by forging at about 1000°C and rolling between 200°C and room temperature was satisfactory for all types of alloys except V–10% Sn and V–10% Al. The mechanical properties deduced from tensile strength tests carried out on alloy samples annealed 1 hour at 1050°C in a vacuum showed that, generally speaking, the addition elements led to an improvement in these properties as compared to those of pure V. After undergoing corrosion tests in a liquid Na loop purified by a cold trap, the alloys became brittle at room temperature. Only the V containing 20% Ti kept its plastic properties. These alloys were covered by a layer of VC. After undergoing treatment in a liquid Na loop purified by a hot trap, all the alloys kept their good mechanical characteristics. The surface layer with which they were covered was composed of two V carbides, VC and γVC, and a V sub-oxide, $VO_{0.9}$. Author (NSA)

N67-33838# Centre National de Recherches Metallurgiques, Liege (Belgium).
INVESTIGATION OF EMBRITTLEMENT OF REACTOR VESSEL STEELS THROUGH PLASTIC FATIGUE Quarterly Report, 1 Apr.–30 Jun. 1966
Dec. 1966 22 p
(Contract EURATOM-005-63-12 TEEB)
(EURAEC-1799; EUR-3339; QR-10) CFSTI: HC $3.00/MF $0.65

Properties of plastic fatigue up to breaking point were measured in two steels (ZA and ZS) and static tensile properties after damage through plastic fatigue at 300°C were determined for steel ZA. The evolution of the bending moment as a function of plastic fatigue cycles with biaxial bending was studied on steel ZS. The plastic fatigue embrittlement at 300°C of a forged ZS steel was measured. Results of plastic fatigue embrittlement of the steels were analyzed from the point of view of the 30 ft lb (4.2 kg) criterion. NSA

N67-33839# Chantiers de l'Atlantique Saint-Nazaire (France).
STEEL STUDIES Quarterly Report, 1 Jul.–30 Sep. 1966
30 Sep. 1966 3 p *Its* Quart. Rept.-2.32
(Contract EURATOM-054-61-12 RDF)
(EURAEC-1798; EUR-3338; QR-6) CFSTI: HC $3.00/MF $0.65

Studies were made on the austenitization, expansion, and stress-relief properties of steel. Steels were superheated to 1250°C and re-austenitized at 900°C at varying rates of heating. It was found that for each steel there is a critical heating rate below which the austenitic superheating grain is hardly or not at all refined, which results in absence of regeneration after superheating. An increase in the content of alloying elements (Ni in particular) appeared to increase the critical rate. Transformation curves were determined for some of the steels studied. NSA

N67-33860# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
LOCAL MODES IN Li–Mg AND Be–Cu ALLOYS [LOKAL'NYE KOLEBANIYA V SPLAVAKH Li–Mg I Be–Cu]
I. Natkanets, K. Parlin'ski, A. Belorek, and M. Sudnik-Khrynkevich 1967 9 p refs In RUSSIAN Submitted for publication
(JINR-P03-3216)

Inelastic neutron scattering experiments with the alloys $Li_{0.05}$–$Mg_{0.95}$, $Li_{0.10}$–$Mg_{0.90}$, $Be_{0.02}$–$Cu_{0.98}$, and $Be_{0.05}$–$Cu_{0.95}$ and the pure metals, Mg and Cu, revealed vibrations of the impurity Li atoms in the Mg lattice of an energy of (35±2) MeV and the Be atoms in the Cu lattice of an energy of (42±2) MeV. The energy of these local modes for these systems, calculated with the assumption that the force constants in the vicinity of the impurity atom remain unchanged, equals 43 MeV (Li–Mg) and approximately 58 MeV (Be–Cu), respectively. It was estimated on the basis of the measured energies of local modes that the average change of the force constants of the impurity atom is approximately 45% for Li–Mg and 56% for Be–Cu. Author (NSA)

N67-33881# Stanford Univ., Calif. Dept. of Materials Science.
[STRUCTURE DEPENDENCE OF VISCOUS DEFORMATION IN METALS AND ALLOYS] Progress Report, 1 Jun. 1966–30 Mar. 1967
Craig R. Barrett and William D. Nix 30 Mar. 1967 21 p refs
(Contract AT(04-3)-326)
(SU-326-P17-1) CFSTI: HC $3.00/MF $0.65

Viscous creep tests were made on pure Al, Al–Fe, and SAP. Special attention was given to dislocation density and stacking fault energy, which directly affect the rate of viscous deformation. The effects of grain size and sample size were also considered, because of their importance in distinguishing between directed vacancy diffusion and dislocation climb. The results showed a linear dependence between creep rate and stress and also that the predominant deformation mechanisms are dislocation motion and grain boundary sliding or probably more accurately, enhanced deformation near grain boundaries. Reasons for this are given. To determine the stress dependence of dislocation density, ρ, during high temperature low stress creep, a series of tests were conducted on an Fe–3% Si alloy. The results demonstrated that if the stress dependence of ρ becomes very small at low stresses then the entire stress dependence of the creep rate should come from the dislocation velocity term, which at high temperatures and low stresses predicts a linear stress dependence. Studies are continuing. NSA

N67-33884# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
EXAGGERATED GRAIN GROWTH IN REACTOR-GRADE HAFNIUM AFTER SMALL DEFORMATIONS
C. D. Calhoun 2 Sep. 1966 28 p refs
(Contract W-31-109-ENG-52)
(KAPL-3193) CFSTI: HC $3.00/MF $0.65

Reactor-grade Hf was cold-rolled at 25°C to reductions of 2, 4, 6.5, 8.5, 10.5, and 12.5%. Samples from this material were heat-treated at 700, 800, 900, 950, and 1000°C for 10, 10^2, 10^3, and 10^4 min. Light microscopy was employed to study the microstructure for exaggerated grain growth. The relations between hardness and X-ray line-broadening as a function of cold-rolling up to 12.5% reduction in area were determined. Exaggerated grain growth appeared to result from the growth of existing grains. An incubation period associated with the exaggerated grain growth varied inversely with cold work. In addition, the ultimate grain size increased with decreasing cold work. Exaggerated grain growth was absent in all heat-treatments at 700 and 800°C, for times of 10^4 min. In metal cold-worked 10.5% or greater, the increase in grain size was not appreciable for any of the heat-treatments employed. Author (NSA)

N67-33887# Johns-Manville Research Center, Manville, N. J.
DEVELOP 1800F—400F FIBROUS-TYPE INSULATION FOR RADIOISOTOPE POWER SYSTEMS Quarterly Progress Report, 2 Jan.–31 Mar. 1967
J. O. Collins 3 Apr. 1967 120 p refs
(Contract AT(30-1)-3633)
(ALO-3633-4) CFSTI: HC $3.00/MF $0.65

Long term testing of Formulations 1999 and 2002 for PbTe RTG applications was completed for several of the physical properties. These included chemical compatibility with PbTe elements (final results still under analysis), load relaxation, and thermal stability. Outgassing and thermal conductivity tests were initiated during this quarter, but have not been completed. Other physical properties such as dynamic response, moisture adsorption/desorption, and shear have been completed. Chemical compatibility in air between SiGe elements and the fibrous candidates has completed the 2000 hr evaluation level. The same test in vacuum is approaching the 1500 hr level. Tests have also been initiated to evaluate the effect of prolonged contact between Irish Refrasil and SiGe bars as determined by Seebeck voltage and resistivity measurements. The effort to improve the temperature resistance of the MIN-K formulations has been concluded with the choice of Formulation 2020. Long term tests on this material were initiated. Author (NSA)

N67-33904* Mitron Research and Development Corp., Waltham, Mass.
DEVELOPMENT OF HIGH STRENGTH REINFORCED ALUMINUM CASTING ALLOYS Final Report, Jun. 1, 1966–May 30, 1967
15 Jun. 1967 75 p refs
(Contract NAS8-20609)
(NASA-CR-87277) CSCL 11F

Experiments were conducted to determine the most satisfactory technique for introducing fibers into a molten alloy matrix to achieve the desired strength levels and the homogeneous distribution of fibers. Effect of whisker geometry and surface coating on the strength of composites was studied, and an effort was made to determine orientation and volume percent of whiskers present in the matrix by using electron probe and electron microscopy techniques. Tensile and hardness tests, metallography, and wet chemical analysis showed the ceramic whisker-CE82 alloy (Al-4Cu-.1Cd-.08 Mg) to exhibit improved mechanical properties as compared to properties of the CE82 control sample. When fiber content was increased above 1.5%, no additional increases in mechanical properties resulted beyond a maximum of 57,350 psi tensile strength, 52,500 psi yield strength, and 3% elongation in test bars treated at 995°F for 20 hours and aged at 375°F for 26 hours. M.W.R.

N67-33918# General Electric Co., Cincinnati, Ohio. Nuclear Energy Div.
SOME PHYSICAL AND MECHANICAL PROPERTIES OF W–25Re–30Mo, W–30Re–30Mo, AND W–25Re
P. N. Flagella, comp. 14 Apr. 1967 18 p refs Revised
(Contract AT(40-1)-2847)
(GEMP-497) CFSTI: HC $3.00/MF $0.65

Physical and mechanical property data for W–25Re–30Mo (at.%), W–Re–30Mo, and W–25Re (wt %) are tabulated. Also, data for some related materials are included for comparison or calculations. NSA

N67-33926# Franklin Inst., Philadelphia, Pa. Research Labs.
THE INFLUENCE OF NON-STOICHIOMETRY ON THE STRUCTURE OF CARBIDES USING FIELD ION MICROSCOPY Progress Report, Period Ending 28 Feb. 1967
L. Cinquina and J. D. Meakin 28 Feb. 1967 21 p refs
(Contract AT(30-1)-3716)
(NYO-3716-1; P-C1870-1; PR-1) CFSTI: HC $3.00/MF $0.65

Studies with field ion microscopy definitely established that at least one carbide, α WC, can be successfully examined using He as imaging gas and that sufficiently well developed net planes are developed to permit an analysis of the atomic positions. The results are described. NSA

N67-33933# Compagnie des Ateliers et Forges de la Loire, Paris (France).
[STEEL STUDIES] Quarterly Report, Jul.–Sep. 1966
Sep. 1966 77 p refs
(Contract EURATOM-033-64-9-TEEF (RD))
(EURAEC-1800; EUR-3340; QR-8) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: mechanical properties of steels without stress at different temperatures; structural evolution in austenitic and austeno–ferritic steels maintained for long periods at temperatures between 400 and 600°C; structural evolution of austeno-ferritic alloys, with and without silicon, at extended exposures between 300 and 600°C; structural evolution of austenitic steels after extended holding times at 500 and 600°C; stress corrosion tensile tests on wire in boiling solutions of Mg or NaCl; tests on 2 mm dia samples mounted on dynamometric rings; stress corrosion test in vapor phase at 500°C; corrosion tests in water at 350°C and steam at 500°C. NSA

N67-33941# Iowa State Univ. of Science and Technology, Ames.
EFFECT OF CARBON ON THE STRENGTH OF THORIUM
Robert Lee Skaggs (Ph.D. Thesis) Feb. 1967 79 p refs
(Contract W-7405-ENG-82)
(IS-T-148) CFSTI: HC $3.00/MF $0.65

The flow stress of Th–C alloys containing from 0.008 to 2.83 atom percent carbon was measured over the temperature range from 4.2 to 573°K. Constant strain rate and constant stress measurements of flow stress were made at rates of deformation from 4×10^{-12} to 1.3×10^{-2} per second. The flow stress was found to be composed of a thermally activated component and an athermal component. The thermally activated component increased linearly with carbon content and with the logarithm of the strain rate. The athermal component is a function of C content and of strain. It was, in general, much smaller than the thermally activated component. The strengthening of Th was due to a strong interaction between randomly distributed C atoms and moving dislocations. A yield point was observed which was a maximum at 250°K and decreased at both higher and lower temperatures. The size of the yield point increased with decreasing grain size, slow cooling from recrystallization temperature, and increasing carbon content. Author (NSA)

N67-33945# California Univ., Livermore. Lawrence Radiation Lab.
FAILURE ANALYSIS OF TIE-RODS ON ALICE BASEBALL MAGNET
W. S. Neef, Jr. 31 Aug. 1966 29 p
(Contract W-7405-ENG-48)
(UCID-15101) CFSTI: HC $3.00/MF $0.65

A group of nine 11-1/2-in.-diam. tie rods with threaded ends failed at 70% design load. They were made of beryllium copper and were used to constrain the large forces encountered in a magnet of baseball seam geometry. This failure occurred during routine operation of the physics experiment but on the first stress cycle at 70% load. Investigation revealed a low-cycle fatigue failure. A heat treatment had been selected which gave great strength but reduced elongation to about 3%; much too brittle a condition when the stress concentration at the threads is considered. Surprisingly little structural damage occurred except for complete destruction of the magnet. The vacuum insulation chamber surrounding the magnet and plasma chamber contained all fragments of the failed rods. The presence of personnel protection baffles around this experiment gave further assurance of the safety of operating personnel in control and diagnostic areas. Author (NSA)

N67-33966# Iowa State Univ. of Science and Technology, Ames.
FATIGUE SOFTENING OF COPPER AND COPPER-ALUMINUM ALLOYS
Joe Howard Doyle (Ph.D. Thesis) Feb. 1967 94 p refs
(Contract W-7405-ENG-82)
(IS-T-157) CFSTI: HC $3.00/MF $0.65

Fatigue softening has been studied in the Cu–Al alloy system using Cu and alloys containing 2, 3.5, and 7 weight percent Al. The samples were prestressed in a partial tensile test and then cyclically loaded in push–pull fatigue. The magnitude of fatigue softening after cyclic loading was found by flow stress measurements and indentation hardness testing to vary directly with the stacking fault energy of the alloys. The Bauschinger effects which occur during the first cycle increase with increasing Al content in these alloys, thus they must be taken into account to prevent them from masking the effects of fatigue softening. Author (NSA)

N67-33970*# TRW Equipment Labs., Cleveland, Ohio. Materials and Processes Dept.
DEVELOPMENT OF HIGH TEMPERATURE COBALT-BASE ALLOYS FOR APPLICATION AS JET ENGINE STATOR VANES Summary Report, 1 Jun. 1965–20 May 1967
J. E. Brokloff and L. D. Graham 20 May 1967 127 p refs
(Contract NAS3-7600)
(NASA-CR-54543; TRW-ER-6723-1) CSCL 11F

The development of a cobalt-base alloy for stator vanes in advanced gas turbine engines is discussed. Statistical plans and computerized multiple regression analysis were used to formulate the experimental alloy compositions. Eighty-five alloys were evaluated in eight different series for stress-rupture and tensile properties at 2125°F. Initially, fifteen elements were employed as alloy additions (W, Ta, C, Zr, Ti, Cr, Ni, V, B, Hf, Mo, Cb, Mn, Re, and Ru). As varying additions were tested in the experiments, the number of alloying elements was reduced to eight (W, Ta, C, Zr, Ti, Cr, Ni, and V). The best alloy developed (VII-H) exhibited a mean 2125°F stress-rupture life of 24 hours at 8000 psi under an argon atmosphere. The alloy did not exhibit sufficient strength to indicate that the program goal of 3000 hour life at 2125°F at 4000 psi under an argon atmosphere would have been achieved. The best alloys in terms of stress-rupture life appeared to be strengthened by a combination of (Ta, Zr, Ti)C precipitates and solid solutioning effects. Author

N67-33979# Army Materials Research Agency, Watertown, Mass.
MECHANICAL PROPERTIES AND BONDING EFFICIENCY OF STEEL COMPOSITES
Charles F. Hickey, Jr. May 1967 10 p refs
(AMRA-TR-67-12; AD-653545) CFSTI: HC $3.00/MF $0.65

The investigation concerns a study of the mechanical properties and bonding efficiency of steel composites. Tensile, slow bend, and hardness data are reported for several alloy combinations. Bonding efficiency of the composite materials, as defined by the tension and slow bend tests, are correlated with ballistic performance results. Results of the program indicate that excellent agreement exists between the tension and slow bend tests as to the quality of the interface bond. These results also correlated well with those obtained from the ballistic tests. Thus, it can be concluded that the tension and slow bend tests can be used as screening tools to define the delamination tendency of steel composites. Author (TAB)

N67-33998# IIT Research Inst., Chicago, Ill.
RESEARCH AND DEVELOPMENT OF PHYSICAL METALLURGY OF TITANIUM Final Report, 1 Aug. 1965–30 Jun. 1966
Frank A. Crossley Apr. 1967 205 p refs
(Contract Nonr-4766(00))
(IITRI-B6041-12; NSRDC-114/67) CFSTI: HC $3.00/MF $0.65

The objectives of the program were to determine the following: (1) the effects of the ternary alpha-soluble additions oxygen, tin, and zirconium, and the beta-stabilizing additions columbium, molybdenum, and vanadium on the extent of Ti–Al primary alpha; (2) the effects of these ternary additions on the kinetics of precipitation of Ti_3Al; and (3) the relationships of the foregoing to mechanical properties. The most significant findings of the three-part study were as follows: oxygen, Zr, Cb, Mo, and V decreased the extent of primary alpha; on the other hand, Sn increased the extent of primary alpha. Extrapolation of data for higher temperatures suggested that below 700C, V may increase the extent of primary alpha in terms of total substitutional solutes. The kinetics study showed that displacement in time between the Ti_3Al precipitation reaction at grain boundaries and within grains is significant in Ti–Al binary and Ti–Al–Sn ternary alloys. Additions of Zr, Cb, Mo, and V retarded the precipitation reaction and appeared to inhibit or suppress it at grain boundaries. The nose of the TTT curves for the precipitation reaction was about 850°C. Impact resistance and tensile ductility went through a minimum upon aging at 850°C and were completely recovered in 500 hr for the Ti-7.1 wt pct Al alloy. TAB

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-32727# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
CARBORANE–SILOXANE ELASTOMERS Final Report, 19 Feb. 1964–18 Feb. 1967
Nathan Mayes 18 Feb. 1967 51 p
(Contract DA-11-070-AMC-852(W))
(RMD-5085-F; AD-652278) CFSTI: HC $3.00/MF $0.65

Toward the objective of synthesizing thermally stable elastomeric carborane-siloxane polymers, silane, carborane, and

silane-carborane intermediates and monomers were prepared. Chlorosilanes, alkoxysilanes and a cyclic siloxane monomer were polymerized by heterogroup condensation, hydrolysis-condensation and ring-opening polymerization techniques. Polymers were obtained that ranged from viscous liquids and brittle solids to elastomeric gums depending on polymer molecular weight and structure. Author (TAB)

N67-32837# Union Carbide Corp., Bound Brook, N. J. Research and Development Dept.

COMPOSITE THERMOPLASTIC/GLASS FILAMENT REINFORCEMENT FOR BUOYANT SUBMARINE CABLES RG-372 (XN-1)/U AND RG-373 (XN-1)/U Interim Report, 10 Feb.–10 May 1967

P. H. Hofer and H. J. Nalepa 10 May 1967 46 p

(Contract NOO140-66-C-0403)

(IR-5; AD-652810) CFSTI: HC $3.00/MF $0.65

The feasibility of producing a buoyant submarine cable, which will meet single-conductor RG-373(XN-1)/U specifications, has been demonstrated. Tests on cable samples, which were constructed on modified commercial equipment, confirmed that the thermoplastic/glass composites, which Union Carbide developed for cable reinforcement, were more than satisfactory. The breaking strength of the cable is more than twice the 1200 pounds specified, while the cable is substantially below the specific gravity limit. Testing at the U. S. Navy Underwater Sound Laboratory showed that the samples produced met all the requirements for the RG-373 cable except for watertightness. The first attempt to produce coaxial cable with Union Carbines thermoplastic/glass composites as strength members was made. Although the composites presented no problems throughout the run, the finished cable was not satisfactory. The waterproofing compound and techniques normally used proved unsuitable in the RG-372 construction. In addition, the cellular polyethylene jackets were not of the proper density. TAB

N67-32915# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.

INVESTIGATION OF HEAT-ACTIVATED CUSHIONING MATERIAL

D. Minuti Mar. 1967 3 p

(NAEC-AML-2598; AD-652600) CFSTI: HC $3.00/MF $0.65

A study was initiated to determine the feasibility of obtaining a solid urethane system which could be foamed-in-place, by the application of heat, in order to provide a cushioning material for ship-to-shore transfers. The best formulation obtained contained the following: diphenyl-4,4-diisocyanate, methacrylamide, 1,1,1-trimethylol propane, polyethylene glycol, unice L ND, 8-hydroxy quinoline. This system foams at approx. 325°F and produces a fine cellular mass 6–8 times its initial volume. The system did not, however, give satisfactory performance when coated on a supporting membrane. TAB

N67-32937# Quantum, Inc., Wallingford, Conn.

DEVELOPMENT OF LOW TEMPERATURE CURE COATING SYSTEMS FOR EXTERNAL SURFACES OF NAVAL AIRCRAFT Final Report, 8 Mar. 1966–7 Mar. 1967

R. L. Taylor, T. Saxton, D. K. McHugh, and J. C. Montermoso 5 Apr. 1967 49 p

(Contract NOw-66-0380)

(AD-651996) CFSTI: HC $3.00/MF $0.65

Several polymer systems have been developed including polyimide-ester (Polymer A) fluorinated imide-ester, (Polymer B) and carboranyl polyimide (Polymer C). Polymer A, when modified with an epoxy, exhibited excellent chemical resistance as well as improved physical properties especially impact strength and scratch resistance. The chemical resistance of Polymer B was especially good, but low values in some physical properties, such as impact strength, indicated the need for further development. The carboranyl polyimide system (Polymer C) which incorporates a carborane nucleus into the polyimide structure appears to hold the most promise as an organic coating, especially in regard to thermal stability. Incorporation of crosslinking showed promising results, but considerable development work is still needed. The specific material which has most closely approximated that sought after in the program is a polyimide-ester made from benzophenone tetracarboxylic dianhydride, heptyl alcohol and oxydianiline. Modified with an epoxy this material has met most nearly the requirements. However, hydrolytic stability needs further improvement and the curing temperature is still high for field applications. Author (TAB)

N67-33066# Linden Labs., Inc., State College, Pa.

CHEMICAL STRENGTHENING OF CERAMIC MATERIALS Summary Report, 7 Apr. 1966–6 Apr. 1967

Henry P. Kirchner, Robert M. Gruver, Dennis R. Platts, and Ralph E. Walker 7 Apr. 1967 156 p refs

(Contract NOw-66-0441)

(AD-652399) CFSTI: HC $3.00/MF $0.65

An investigation of the effect of compressive surface layers on the strength of polycrystalline ceramic bodies is described. Low expansion surface layers were formed on conventional ceramics by chemical reactions at high temperatures. Failure, by shearing of the surface layers, was prevented by establishing gradual variations in composition within the body. Chemical strengthening was attempted with alumina, titania, spinel, magnesia, forsterite, steatite, nickel oxide, silica and cordierite bodies and was achieved with several of these materials. Glazing and quenching also resulted in improved flexural strength. Combined processes involving chemical strengthening, atmospheric treatments, glazing and quenching were investigated. In some cases strength increases of more than 90% were observed. The thermal shock resistance of some of the samples was improved. Abrasion of the surfaces of some of the treated samples did not result in loss of strength. Author (TAB)

N67-33272*# Narmco Industries, Inc., San Diego, Calif.

THE DEVELOPMENT OF STRUCTURAL ADHESIVE SYSTEMS SUITABLE FOR USE WITH LIQUID OXYGEN Summary Report IV, 1 Jul.–30 Nov. 1966

Jerome Hollander, Floyd D. Trischler, Edward S. Harrison, Robert M. De Borde, and Beatrix Y. Sanders Jan. 1967 74 p refs

(Contract NAS8-11068)

(NASA-CR-87156) CFSTI: HC $3.00/MF $0.65 CSCL 11A

Work was concentrated on the preparation of fluorinated polyurethanes. Seven polyurethanes were prepared, five of which were tested for liquid oxygen compatibility. Two polyurethanes were synthesized which show real promise as LOX-compatible adhesives. One polyurethane was prepared from tetrafluoro-m-phenylene diisocyanate and a polyether of perfluoropropylene oxide. The other polyurethane was prepared from tetrafluoro-p-phenylene diisocyanate and a polyether of hexafluorobenzene and hexafluoropentanediol. Initial lap shear specimens bonded with each of these polyurethanes gave extremely promising results. Two other polyurethane systems were synthesized; one by reaction of the polyether from chloropentafluoroisopropyl acohol with either of the tetrafluoro-phenylene diisocyanates, the other by reaction of tetrafluoro-m-phenylene Diisocyanate with a hydroxyl-terminated polyurethane from hexafluoropentanediamine and hexafluoropentamethylene bischloroformate. Preparations and synthetic studies were carried out on a number of additional monomers and prepolymers. Author

N67-33413# Battelle Memorial Inst., Columbus, Ohio.

DENSE ISOTROPIC GRAPHITE FABRICATED BY HOT ISOSTATIC COMPACTION

Donald C. Carmichael, William C. Chard, and M. Clifford Brockway 31 Mar. 1967 36 p refs (Contract W-7405-ENG-92)) (BMI-1796) CFSTI: HC $3.00/MF $0.65

Graphite bodies were prepared by the hot-isostatic-compaction process to obtain densities in the range of 2.20 to 2.24 per cm^3 (95 to 99 percent of theoretical) with a high degree of isotropy. Of the graphite starting materials which were compacted and tested, a high-purity artificial powder and a commercial bulk (not powdered) material resulted in this combination of properties. The processing was accomplished at approximately 2700°C for 30 min using a He-gas pressure of 900 atm. The isotropic characteristics of the materials were determined by measurements of X-ray diffraction, electrical resistivity, and linear thermal expansion. On the basis of the property evaluations, samples of the most dense and isotropic materials were fabricated for irradiation testing at Battelle–Northwest. Author (NSA)

N67-33481# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HIGH MOLECULAR COMPOUNDS

22 Mar. 1967 39 p refs Transl. into ENGLISH from Vysokomolekul. Soedin. (Moscow), v. 7, no. 2, 1965 p 224–254, 305–307 (FTD-MT-65-537; AD-652477)

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N67-33482# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF SURFACE ACTIVE SUBSTANCES ON THE MORPHOLOGY OF POLYURETHANE

O. G. Tarakanov and A. I. Demina *In its* High Mol. Compds. 22 Mar. 1967 p 1–6 refs (See N67-33481 19-18)

Influence of various classes of surface active materials on the development of morphological structures of polyurethanes is examined in terms of applications to the production of foam plastics, fibers, varnishes, and rubbers. Surface active substances with straight chain molecules and of low surface activity with respect to polymer solution promote the ordering of the polymer structure. High surface activity hinders structure development, and hindrance increases with molecular weight and branching of the compound. M.W.R.

N67-33483# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRUCTURAL TRANSFORMATIONS DURING THERMAL TREATMENT OF POLYACRYLONITRILE

V. A. Kargin and I. A. Litvinov *In its* High Mol. Compds. 22 Mar. 1967 p 7–13 refs (See N67-33481 19-18)

Electron microscopy and X-ray analysis indicate that the initial high molecular structure of crystalline polyacrylonitrate does not change with thermal treatment, and that initial anisotropy can be preserved up to 800°C. When unoriented and nonoriented samples and fibers of polyacrylonitrile are subjected to heat treatment, the initial orientation of the polymer remains, but there is a transition to a cyclical structure in the polymer. Changes in the chemical structure do not affect the orientation or nature of the initial molecular structure. M.W.R.

N67-33484# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPRAISAL OF THE DEGREE OF ORIENTATION MACROMOLECULES IN POLYMER FIBERS BY THE METHOD OF NUCLEAR MAGNETIC RESONANCE

A. I. Kol'tsov and M. V. Vol'kenshteyn *In its* High Mol. Compds. 22 Mar. 1967 p 15–24 refs (See N67-33481 19-18)

Anisotropy of nuclear magnetic resonance spectra of oriented polymers is suggested for determining the degree of orientation of the macromolecules composing polymer fibers. The proposed method is based on the theory of second moments of NMR lines and is applicable for an unknown distribution function of the polymer chains. Some calculations are included for polyvinyl alcohol, polyacrylonitrile, and polyvinyl chloride; and a difference in the anisotropy of the second moments is noted for flat and spiral polymer chains. Determining the dominating conformation of the chains is demonstrated by comparing experimental and theoretical dependence of the second moment of the NMR lines on the angle between the magnetic field direction and the axis of the fiber. M.W.R.

N67-33767# Naval Research Lab., Washington, D. C.

DEVELOPMENT OF INTERIOR PAINTS FOR NUCLEAR SUBMARINES

T. R. Walton *In its* The Present Status of Chem. Res. in Atmosphere Purification and Control on Nucl.-Powered Submarines 11 Jan. 1967 p 27–32 refs (See N67-33761 19-05)

In view of the stipulations that: (a) all painting with organic-solvent-thinned paints must be completed on nuclear submarines five days prior to submergence; (b) that during this five-day period, a maximum of one quart of organic-solvent-thinned paint per day may be used; (c) if large areas of painting are necessary during this five day period, then an approved proprietary water paint base must be used; and (d) no painting should be done while on patrol; a study was undertaken to develop a high quality paint for use during this five-day interval under sealed ship conditions which would allow much of the interior painting to be done by the ship's personnel after the submarine had departed on its patrol. Reported are results of an evaluation of the following four principle paint systems: (1) a latex paint containing a chlorinated additive and antimony oxide (Sb_2O_3); (2) a paint based on a vinyl chloride/acrylic copolymer emulsion and Sb_2O_3; (3) a paint based on a convertible, water soluble chlorinated alkyd and Sb_2O_3; and (4) a paint based on a water soluble linseed oil derivative and containing a chlorinated additive and Sb_2O_3. S.C.W.

N67-33868*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INVESTIGATION OF STERILIZABLE COMPOUNDS FOR EMBEDMENT OR CONFORMAL COATING

M. W. Hanchette Feb. 1967 12 p (NASA-TM-X-55710; X-623-67-79) CFSTI: HC $3.00/MF $0.65 CSCL 11A

After a thorough literary search was made on the subject, a number of compatible compounds which appeared to have possible use for encapsulating or conformal coating were chosen, and sample quantities tested. Preliminary tests were conducted by forming simple molds from aluminum foil, mixing the compounds according to directions, and pouring the compounds upon narrow

strips of printed circuit boards placed in the molds. After curing, the samples were baked at 145°C for 24 hours or more. On the basis of warpage data, which could cause breakage of delicate components and connections, Stycast 1090/9 was selected as the most suitable compound for conformal coating or encapsulating. It is also the lightest compound with a specific gravity of .84, and has very good mechanical and electrical properties. In addition to test results, recommendations for designing circuit boards and usage of the compound are presented. A.G.O.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-32721# Joint Publications Research Service, Washington, D. C.
ONE CLASS OF SELF-TEACHING RECOGNITION ALGORITHM
G. M. Adel'son-Vel'skiy et al 12 Jun. 1967 6 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 173, no. 3, 1967 p 532–534
(JPRS-41350; TT-67-31984) CFSTI: $3.00

An algorithm for nonintersecting subsets is described. Complete matching in finding the combinations of characteristics and their values is avoided by using iteration algorithms previously suggested. N.E.N.

N67-32739# Hebrew Univ., Jerusalem (Israel).
THE DEFINABILITY OF CARDINAL NUMBERS
Azriel Levy Mar. 1967 44 p refs
(Contract F61052-67-C-0055)
(TR-26; AD-653298) CFSTI: HC $3.00/MF $0.65

Cardinal numbers are known to be definable in set theory with the axiom of choice or with the axiom of foundation. In the absence of these two axioms the notion of a cardinal number is shown to be undefinable in ZF, in several strong senses. The proofs use models of the Fraenkel-Mostowski type. TAB

N67-32787# Sandia Corp., Albuquerque, N. Mex.
TABLES FOR THE SQUARE ROOT OF COMPLEX NUMBERS
Charles W. Harrison, Jr. and Eugene A. Aronson Jan. 1967 138 p
(Contract AT(29-1)-789)
(SC-R-67-1052) CFSTI: HC $3.00/MF $0.65

The propagation constant of an electromagnetic field existing in a dissipative medium is obtained by taking the square root of a complex number. In order to take the drudgery out of the numerical determination of this constant, the tables presented herein were prepared. Certain useful relations between the real and imaginary parts of the square roots of the square of the propagation constant are developed. The procedure to follow in evaluating $\sqrt{\pm a \pm jb}$ from the tables is described in detail. Author (NSA)

N67-32781# Wisconsin Univ., Madison. Dept. of Statistics.
ROBUST ESTIMATES OF LINEAR TREND IN MULTIVARIATE TIME SERIES
G. K. Bhattacharyya Apr. 1967 21 p refs
(Contract Nonr-1202(17))
(TR-107; AD-653267) CFSTI: HC $3.00/MF $0.65

Median and weighted median estimates are obtained for the linear trend parameters of a univariate time series by applying the Hodges–Lehmann method to some well known nonparametric tests for trend. The estimation procedure is extended to the multivariate trend model and asymptotic efficiency properties relative to the classical estimates are studied. TAB

N67-32789# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON THE RATE OF CONVERGENCE IN RENEWAL AND MARKOV RENEWAL PROCESSES
Jozef L. Teugels Jun. 1967 97 p refs Its Mimeograph Ser. No. 107
(Grant AF-AFOSR-955-65)
(AD-652492) CFSTI: HC $3.00/MF $0.65

For the special case of a distribution function that tends to one exponentially fast, the three basic renewal theorems are proved by the same method. Moreover an estimate of the remainder term is obtained. This extends results of M. R. Leadbetter. Series expansions are obtained for the renewal function by using matrix methods. Similar methods apply equally well to the Psi-renewal moments. Author (TAB)

N67-32790# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
STOCHASTIC REGIME PROCESSES
Rolf K. Adenstedt Mar. 1967 83 p refs
(Contract DA-28-043-AMC-00183(E))
(TR-1; AD-652287) CFSTI: HC $3.00/MF $0.65

A type of stochastic processes, called a regime process, based upon the presence of intervals of statistical regularity is defined and its properties considered. Measurability of the process, its finite-dimensional distributions, stationarity, limiting behavior and ergodicity are considered. A detailed study is made of the case when the regime process is based on an underlying Markov chain, and a procedure for estimating the distribution of the underlying process is outlined. Author (TAB)

N67-32793# California Inst. of Tech., Pasadena. Dept. of Mathematics.
REDUCED POWERS OF THE REAL NUMBER SYSTEM AND EQUIVALENTS OF THE HAHN-BANACH EXTENSION THEOREM
W. A. J. Luxemburg May 1967 32 p refs
(Contract N00014-66-C-0009-A04)
(TR-2; AD-653071) CFSTI: HC $3.00/MF $0.65

One of the main principles of functional analysis is the so-called Hahn–Banach extension theorem. In the present paper we are mainly interested in the question which other statements in mathematics can be shown to be effectively equivalent to the Hahn–Banach extension theorem. The main result can be phrased as follows: the Hahn–Banach extension theorem is effectively equivalent to the statement every non-degenerate Boolean algebra admits a nontrivial measure. The method being used is to consider the linear ring of finite elements in a reduced power of the real number system. It is shown that this linear ring is an abstract M-space in the sense of Kakutani. Some of the consequences of this fact are given in the present paper. TAB

N67-32838 Illinois Univ., Urbana. Dept. of Psychology.
ASSOCIATION IN A CLASS OF GROWTH FUNCTIONS
Rolf E. Bargmann (Georgia Univ.), and Ledyard R. Tucker Dec. 1966 55 p refs
(Contracts Nonr-1834(39); N00014-66-C0010A03)
(AD-643099) CFSTI: HC $3.00/MF $0.65

Birth models with time-dependent transition probabilities are useful for the analysis of growth functions. The availability

model (in contrast to the reliability model) has been adopted, since initial time of observation or zero score is rarely a physically meaningful quantity in growth functions. The Weibull class has been selected as a class of growth functions. The report contains description of methods for maximum-likelihood estimation of the Weibull parameter, and estimation of the weighted regression parameters. A measure of association is defined from the regression analysis, and called the index of biserial association. A package of computer programs for the 7094 has been prepared, and documented in the appendix. Results of the analysis of some sampling experiments have been reported for illustration. Author (TAB)

N67-32852# California Inst. of Tech., Pasadena. Dept. of Mathematics.
A NEW APPROACH TO THE THEORY OF MONADS
W. A. J. Luxemburg Apr. 1967 124 p refs
(Contract N00014-66-C-0009-A04)
(TR-1; AD-653070) CFSTI: HC $3.00/MF $0.65

The paper deals with the general theory of monads and its applications. In its general context the theory is part of non-standard analysis. Many new results concerning the notion of monad of a family are given. Furthermore it is shown that for a detailed description of a monad, saturated models are more appropriate than enlargements. As one of the many applications it is shown that the standard part of any internal set in a saturated model of a topological space is closed. TAB

N67-32933# Hebrew Univ., Jerusalem (Israel).
ALGEBRAIC, RATIONAL AND CONTEXT-FREE POWER-SERIES IN NON-COMMUTING VARIABLES
Eliahu Shamir 26 Jan. 1967 20 p refs
(Contract N62558-4895)
(TR-25; AD-653262) CFSTI: HC $3.00/MF $0.65

The classes of algebraic and rational power-series on non-commuting variables are introduced as the solutions of certain polynomials systems. These systems can be viewed as context-free grammars with weighted productions - the weights being taken from a ring. This observation is used to derive basic properties of those classes of power-series. TAB

N67-32936*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORETICAL COMPUTATIONS OF THE OUTGOING INFRARED RADIANCE FROM A PLANETARY ATMOSPHERE
Virgil G. Kunde Washington, NASA, Aug. 1967 121 p refs
(NASA-TN-D-4045) CFSTI: $3.00 CSCL 03B

The solution to the radiative transfer equation for a non-gray absorbing atmosphere in local thermodynamic equilibrium was programmed for an IBM 7094 computer to calculate theoretically the outgoing infrared radiance in five wave number spectral intervals. The spectral range covered is from 5 to 20 microns. The theoretical outgoing radiances may be utilized in several ways: (1) to assist in selection of the desired spectral characteristics for infrared satellite experiments, (2) to test the validity of balloon and satellite observations, and (3) to aid in the analysis of planetary infrared radiation data. Theoretical thermal emission spectra were computed for several representative model atmospheres for Earth and Mars. These spectra illustrate that a considerable amount of information is available from radiation data of five wave number resolution. This information allows the recovery of the atmospheric and surface parameters from measured thermal emission spectra. Author

N67-32975*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TABLES OF TWO-SIDED TOLERANCE FACTORS FOR NORMAL DISTRIBUTIONS
R. G. Chamberlain and A. G. Benedict 15 Jun. 1965 14 p refs
(Contract NAS7-100)
(NASA-CR-87306; JPL-TM-33-217) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Comprehensive tables of two-sided tolerance factors for the normal distribution are presented. These tables have been prepared by means of an IBM 7090 computer program. Author

N67-33038# Wisconsin Univ., Madison Dept. of Statistics.
BAYESIAN ANALYSIS OF LINEAR MODELS WITH TWO RANDOM COMPONENTS (WITH SPECIAL REFERENCE TO THE BALANCED INCOMPLETE BLOCK DESIGN)
G. C. Tiao and N. R. Draper Feb. 1967 39 p refs
(Contracts Nonr-1202(17); Grant NSF GP-5519)
(TR-102; AD-650278) CFSTI: HC $3.00/MF $0.65

The paper considers linear models which contain two random components and enable representation of general designs with block effects random. It shows how, within a Bayesian framework, to combine the intra- and inter-block information about the location parameters. The balanced incomplete block design, an important special case, is considered in detail and illustrated by an example. A simple approximation to the marginal distribution of an individual contrast is also presented and illustrated. TAB

N67-33045# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
EXPECTED NUMBER OF CROSSINGS OF AN ARBITRARY CURVE BY A NON-STATIONARY GAUSSIAN PROCESS
Gordon B. Crawford Jan. 1967 20 p refs *Its* Mathematical Note No. 500
(D1-82-0596; AD-649603) CFSTI: HC $3.00/MF $0.65

A formula is derived for the expected number of crossings of an arbitrary, possibly discontinuous, curve in a time interval (0, T) by a continuous non-stationary normal process. It is shown that a formula analogous to that of M. R. Leadbetter and J. D. Cryer holds under conditions more general than they considered. Author (TAB)

N67-33046# Wisconsin Univ., Madison Dept. of Statistics.
NONPARAMETRIC ESTIMATION IN MARKOV PROCESSES
George G. Roussas Apr. 1967 13 p refs
(Contract Nonr-1202-17; Grant NSFGP-6242)
(TR-110; AD-653272) CFSTI: HC $3.00/MF $0.65

The purpose of the present paper is to consider the non-parametric estimation of densities in the case of Markov processes. Asmyptotically unbiased estimates for the initial and (two-dimensional) joint densities are constructed. These estimates are shown to be consistent in quadratic mean, and furthermore a consistent, in the probability sense, estimate for the transition density is obtained. It is shown that, under suitable conditions, all three estimators mentioned, properly normalized, are asymptotically normal. TAB

N67-33086# State Univ. of New York at Buffalo.
SOME TOPICS RELATED TO TRANSFORMATIONS, DISTRIBUTION FUNCTIONS AND STOCHASTIC PROCESSES Final Report
Norman C. Severo, Paul J. Schillo, and Robert H. Rodino Wright-Patterson AFB, Ohio, ARL, Nov. 1966 93 p refs
(Contract AF 33(657)-9885)
(ARL-66-0231; AD-651648) CFSTI: HC $3.00/MF $0.65

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1. ON THE ASYMPTOTIC DISTRIBUTION OF A TRANSFORMED RANDOM VARIABLE p 1-8 refs (See N67-33087 19-19)

2. SUPPLEMENT TO CHAPTER II OF ARL 65-75 p 9-46 (See N67-33088 19-19)

3. ROBUSTNESS OF TESTS p 47-62 refs (See N67-33089 19-05)

4. TWO THEOREMS ON SOLUTIONS OF DIFFERENTIAL-DIFFERENCE EQUATIONS AND APPLICATIONS TO EPIDEMIC THEORY p 63-83 refs (See N67-33090 19-19)

N67-33087# State Univ. of New York at Buffalo.
ON THE ASYMPTOTIC DISTRIBUTION OF A TRANSFORMED RANDOM VARIABLE
In its Some Topics Related to Transformations, Distribution Functions and Stochastic Processes Nov. 1966 p 1-8 refs (See N67-33086 19-19)

The purpose of this paper is to generalize a theorem regarding the asymptotic distribution of a transformed normal random variable by relaxing the assumption of normality and removing the requirement that the parameters μ_Y and σ_Y of the distribution of the random variable Y be the mean and variance, respectively. A result analogous to the abovementioned theorem is obtained for the class of location-scale parameter distributions. Examples are given which show that the conditions given are sufficient, but not necessary, for the existence of an asymptotic distribution of a transformed random variable. Author

N67-33088# State Univ. of New York at Buffalo.
SUPPLEMENT TO CHAPTER II OF ARL 65-75
In its Some Topics Related to Transformations, Distribution Functions and Stochastic Processes Nov. 1966 p 9-46 (See N67-33086 19-19)

This supplement refers to a paper on some properties of distribution functions and transformations that induce one another. That paper provided necessary and sufficient conditions under which an ordered pair (F,G) of distribution functions in a subset D of a set of Baire functions is a compatible pair. The present supplement carefully examines some special ordered pairs of distribution functions in D and determines whether or not they are compatible pairs. Illustrated are ways of deciding if a given univariate random variable X can be transformed into a given univariate random variable Y, and procedures are given for defining various transformations of X into Y in the event that one such transformation is known to exist. K.W.

N67-33090# State Univ. of New York at Buffalo.
TWO THEOREMS ON SOLUTIONS OF DIFFERENTIAL-DIFFERENCE EQUATIONS AND APPLICATIONS TO EPIDEMIC THEORY
In its Some Topics Related to Transformations, Distribution Functions and Stochastic Processes Nov. 1966 p 63-83 refs (See N67-33086 19-19)

Two theorems that provide simple iterative solutions of special systems of differential-difference equations are presented. The first system consists of linear differential equations whose coefficient matrices are triangular, have constant elements, and have diagonal elements equal to each other at most in pairs. The equations of the second system also have constant triangular coefficient matrices, such that whenever there are equal diagonal elements then sufficient conditions are imposed on the matrices themselves so that the solutions involve only sums of exponential terms. The theorems are applied to the simple stochastic epidemic and to the general stochastic epidemic, respectively, in each of which the initial distribution of the number of uninfected susceptibles and the number of infectives are arbitrary but the total population size is assumed bounded. Author

N67-33093# Wisconsin Univ., Madison. Mathematics Research Center.
ON CANONICAL BASES FOR SUBGROUPS OF AN ABELIAN GROUP
Henry B. Mann Feb. 1967 24 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-727; AD-651260) CFSTI: HC $3.00/MF $0.65

A basis $\omega_1 \ldots \omega_n$ of an Abelian group G is called canonical for the subgroup H if $H = [d_1\omega_1, \ldots, d_s\omega_s]$. Necessary and sufficient conditions are given that a basis exists which is canonical for a set $H_1, \ldots, H_s$ of subgroups of G. The result is applied to matrices, to n dimensional lattices and to algebraic numberfields. Author (TAB)

N67-33095# International Centre for Theoretical Physics, Trieste (Italy).
ALGEBRAIC FORMULATION OF DYNAMICAL PROBLEMS
P. Budini Mar. 1967 26 p refs Lectures given at the Intern. Universitaetswochen fuer Kernphysik Submitted for publication
(IC-67/18)

It is shown how the algebraic method can be employed to solve some dynamical problems and the important role that is played in this frame, by the Casimir operators. In particular, while in the nonrelativistic case the Casimir operator of the spectral algebra gives the connection between the mass operator and the Casimir operator of the symmetry algebra, in the relativistic cases considered one has still a one-to-one dependence of the Casimir operator of the spectral algebra on that of the symmetry algebra, but this dependence is no longer sufficient to give the mass spectrum which is obtained by introducing the Casimir operator of the inhomogeneous spectral algebra which leads to an equation of the Klein–Gordon type, giving the mass spectrum implied by the equation. In this way the whole procedure is kept at the algebraic level. NSA

N67-33120# Pennsylvania Univ., Philadelphia.
DIFFERENTIABLE ACTIONS ON HOMOTOPY SEVEN SPHERES, III Interim Technical Report
Chung-tao Yang and D. Montgomery May 1967 22 p refs
(Contract DA-31-124-ARO(D)-123)
(AROD-2056-18-M; Rept.-5; AD-651967) CFSTI: HC $3.00/MF $0.65

Denote by G the circle group of complex numbers of absolute value 1, by Z2 the subgroup of G of order 2 and by Z the group of integers. Further, denote by Il an infinite cyclic group of equivariant diffeomorphism classes of free differentiable actions of G on homotopy 7-spheres. It has been shown that there is an isomorphism tau of Z onto Il such that for an integer i, if a free differentiable action of G on a homotopy 7-sphere sigma sub i is in tau(i), then the first Pontrjagin class of the Orbit space sigma sub i/G is given by P(sigma sub i/G) = (24i + 4) a sub i to the second power where a sub i is a generator of H squared (sigma sub i/G;Z). It is known that sigma sub i has the ordinary differentiable structure if i = 0 or 6 mod 14. The purpose of this paper is to investigate the free differentiable actions of Z2 on sigma sub i obtained from the actions of G. Our main results is that the Browder-Livesay invariant of (Z2, sigma sub i) is equal to 8i so that for i not equal to j, (Z2, sigma sub i) and (Z2, sigma sub j) are not piecewise linearly equivalent. Author (TAB)

N67-33150# Wisconsin Univ., Madison. Dept. of Statistics
ASYMPTOTIC NORMALITY OF CERTAIN FUNCTIONS DEFINED IN A MARKOV PROCESS
George G. Roussas Apr. 1967 21 p refs
(Contract Nonr-1202(17); Grant NSF GP-6242)
(TR-109; AD-653271) CFSTI: HC $3.00/MF $0.65

In the present paper it is first proved that, under essentially the same conditions, the quotients (summation from m=1 to m=n of g sub m/summation from m=1 to m=n of f sub m) and (summation from m=1 to m=n of f sub m/summation from m=1 to m=n of g sub m) properly normalized, are also asymptotically normal. Next, the functions f and g are also considered to be dependent on n—the number of the random variables X sub j, j=1,...,n—and asymptotic normalities similar to the ones mentioned above are established under a number of conditions. The results obtained here are useful in statistical applications and are applied in the problem of non-parametric estimation in Markov processes. TAB

N67-33178# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
SELECTION PROCEDURES BASED ON RANKS: SCALE PARAMETER CASE
Prem S. Puri (New York Univ.) and Madan L. Puri Apr. 1967 19 p refs *Its* Mimeograph Series No. 105
(Contracts AF 33(615)-67C1244; Nonr-285(38); Grant NIH GM-10525)
(AD-652613) CFSTI: HC $3.00/MF $0.65

Selection procedures based on ranks for ranking c populations with regard to scale parameters and for selecting a subset containing populations 'better than a standard' are proposed and their properties studied. Author (TAB)

N67-33180# Cornell Univ., Ithaca, N. Y. Dept. of Industrial Engineering and Operations Research.
THE EFFICIENCY OF A NONPARAMETRIC SELECTION PROCEDURE: LARGEST LOCATION PARAMETER CASE
Edward J. Dudewicz Dec. 1966 62 p refs
(Contract Nonr-401(53))
(TR-17; AD-650425) CFSTI: HC $3.00/MF $0.65

For the general problem of selecting that one of k populations pi sub 1,...,pi sub k which has the highest probability of producing the largest observation, Bechhofer and Sobel have suggested a procedure which is nonparametric in the sense that the cumulative distribution function (c.d.f.)F sub i (.) of observations from pi sub i may be different for each i (i=1,...,k) and unknown. If the c.d.f. of observations from pi sub i is known to have the same form (which may be unknown) and differ only in location for each i, the c.d.f. of observations from pi sub i may be written as F sub i(x)=F (x-nu sub i) (i=1,...,k). Then the above-posed the one suggested by Bechhofer and Sobel is one possible recourse. However, even in this circumstance, it is of interest to know how the procedure performs under various possible parametric alternatives. In this paper we determine (under specific parametric alternatives) how much one pays (in terms of increased sample sizes) for the nonparametric procedure's certainty of guaranteeing a reasonable requirement on the performance characteristic function, in the largest location parameter case. It turns out that the nonparametric procedure has a low efficiency relative to the specific parametric alternatives considered and will therefore be useful against these alternatives (and, presumably, many others also) only when real doubt exists as to the form of the actual distribution. Author (TAB)

N67-33224# Los Alamos Scientific Lab., N. Mex.
ERROR BOUNDS ON NUMERICAL SOLUTIONS OF DIRICHLET PROBLEMS FOR QUASILINEAR ELLIPTIC EQUATIONS
Thurman G. Frank (Ph.D. Thesis—Texas Univ.) 10 May 1967 150 p refs
(Contract W-7405-ENG-36)
(LA-3685) CFSTI: HC $3.00/MF $0.65

Let R be a closed, bounded, simply connected region in the plane. Let P denote the Dirichlet problem $Au_{xx}+2Bu_{xy}+Cu_{yy}=G$ on R in which A, B, C, G depend on x, y, u, u_x, u_y. It is assumed that A, B, C satisfy a uniform ellipticity condition and a condition which enables uniqueness of the solution of P to be established by means of a maximum principle; also, it is assumed that R and the coefficient functions are such that $u \in C^4$ on R. Several finite difference analogues of P are studied which use, essentially, central differences except near the boundary. One such scheme uses the method of Bramble and Hubbard to treat the term $2Bu_{xy}$. It is shown that the solutions of the finite difference analogues converge, with decreasing mesh width h, to the solution of P. Moreover, the error is $O(h^p)$ with p either one or two depending on which particular combination of difference equations in the interior and at the boundary of R is used. Author (NSA)

N67-33268# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING CERTAIN PROPERTIES AND THE LIMIT THEOREM OF A SIMPLE FUNCTION OF THE ITO RANDOM INTEGRAL
Waung Chia-Kang 25 Jan. 1967 26 p refs Transl. into ENGLISH from Shu Hsuett Hseuh Pao, v. 14, no. 4, 1964 p 517–531
(FTD-HT-66-607; AD-653550) CFSTI: HC $3.00/MF $0.65

This paper discusses the properties and limit theorems of a sample function of the Ito stochastic integral. Most of the results in this paper can be regarded as a generalization of Cogburn and Tuckers limit theorem for a function of increments of a decomposable process. The paper begins with a derivation of certain properties of the sample function of the stochastic process defined by an Ito stochastic integral. Then the author uses the derived result in an investigation of analogous limit theorems. Five theorems are stated and proved in the paper. The first three theorems show that: (1) the sample function y(t) with a staircase has probability 1; (2) the sample function y(t) with a pure step function has a finite discontinuity in finite times; (3) the sample function y(t) has a bounded magnitude. The last two theorems only indicate the probability limits of the function of the increments of x(t). TAB

N67-33274# Stanford Univ., Calif. Computer Science Dept.
THE COMPUTATION OF BOUNDS FOR THE INVARIANT SUBSPACES OF A GENERAL MATRIX OPERATOR
James M. Varah 26 May 1967 246 p refs
(Contract Nonr-225(37))
(CS-66; AD-652921) CFSTI: HC $3.00/MF $0.65

Let A be a general n X n complex matrix. We consider the problem of finding the invariant subspaces of A, i.e. solving AX=XM for X nonsingular and M block-diagonal. We first consider finding the eigensystem of A (i.e. M diagonal), assuming approximations to the eigenvalues are given. We show how to find approximate eigenvectors and rigorous machine bounds for the errors in the approximate eigensystem. Then we show how to find approximations and rigorous error bounds for higher-dimensional invariant subspaces of matrices which are close, in a sense we describe, to defective matrices, and for which poor results would be otained for the eigensystem. Burroughs B5500 Extended Algol programs using these methods are also given. Author (TAB)

N67-33360# California Univ., Los Angeles. Western Management Science Inst.
A NEW APPROACH TO DISCRETE MATHEMATICAL PROGRAMMING
G. W. Graves and A. B. Whinston May 1967 24 p refs Supported in part by ONR, NSF, and Ford Foundation *Its* Working Paper No. 117
(AD-654162) CFSTI: HC $3.00/MF $0.65

The paper presents an algorithm for solving the zero-one integer programming problem, in contrast to the usual approach, which reduces the problem to finding the optimal values for

variables restricted to values of zero and one, we view the problem as finding an optimal map among a class of mappings of one finite set into another. The basic approach is to characterize the statistical structure of the finite class of maps. Our technique consists of trying to identify the optimal feasible map in a class of maps, by introducing random variables as functionals on the class of maps. We derive explicitly the statistical properties of the class of maps associated with the zero-one integer programming problem. Using the mean and variance-covariance matrix the idea of confidence level enumeration is developed. Author (TAB)

N67-33482# European Space Vehicle Launcher Development Organization, Paris (France).
GUIDE TO HAMILTONIAN TECHNIQUE FOR FORMULATION OF ORBITAL PROBLEMS [GUIDE A LA TECHNIQUE HAMILTONIENNE POUR LA FORMULATION DES PROBLEMES ORBITAUX]
E. Cambi May 1967 53 p In FRENCH
(ELDO-TM-F-42) CFSTI: HC $3.00/MF $0.65

An explanation is given of the technique of the canonical equations applied to orbital problems. For instance the problem of orbital movement in the gravitational field of a flattened earth is discussed by the Hamiltonian technique. Author (ESRO)

N67-33486 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugmechanik.
SURVEY ON THE POSSIBILITIES OF A CALCULATION OF PROBABILITY INTEGRALS OF AN N-DIMENSIONAL NORMAL DISTRIBUTION [UEBERSICHT UEBER MOEGLICHKEITEN EINER BERECHNUNG VON WAHRSCHEINLICHKEITSINTEGRALEN EINER N-DIMENSIONALEN NORMALVERTEILUNG]
W. Konau Feb. 1967 26 p refs In GERMAN; ENGLISH summary
(DLR-MITT.-67-07)

Based on surveys in literature the possibility of numerical calculation is investigated for probability integrals for n-dimensional normal variates (n>2)—shortly called n-dimensional normal integrals. The investigation is restricted to integrals which have as lower limit minus infinite, and as upper limit the coordinates of a point in the n-dimensional space. Results indicate that only few special cases of the general integral could be calcblated with either very small values of n or with special correlations or specialized integration limits. Author

N67-33490# Wisconsin Univ., Madison. Dept. of Statistics.
LEAST SQUARES ANALYSIS WITH A DYNAMIC MODEL
G. E. P. Box, G. M. Jenkins, and D. W. Wichern Mar. 1967 24 p refs
(Grant AF-AFOSR-1158-66)
(TR-105; AD-653265) CFSTI: HC $3.00/MF $0.65

Frequently in the study of dynamic systems one is faced with estimating the parameters in a mathematical model. A typical example of the situation we have in mind might arise in the study of the dynamics of a chemical process. In such a case, the x's would be manipulated inputs such as temperatures and concentrations while the y would represent the observed system output. For example, y might be the concentration of a particular chemical product. Even in simple cases one may be involved in estimation difficulties due to the number of parameters and the nonlinearity of the situation. To determine whether existing non-linear estimation procedures could be used to obtain precise estimates of the parameters in a mathematical model, it was decided to run an experiment with manufactured data. Author (TAB)

N67-33510# Naval Ordnance Test Station, China Lake, Calif.
QUADRATIC APPROXIMATION OF THE LOGARITHMIC FUNCTION
Eldon L. Dunn May 1967 28 p ref
(NOTS-TP-4223; AD-652000) CFSTI: HC $3.00/MF $0.65

Methods of fitting quadratic expressions to the function y = 20 log x between x = 0.5 and x = 100 are described. The resulting quadratics are useful in simplifying the solution of certain transcendental equations by reducing them to algebraic equations. Author (TAB)

N67-33833# Information Research Associates, Inc., Lexington, Mass.
ON SELECTING VARIABLES FOR PATTERN CLASSIFICATION
Poduri S. R. S. Rao Jun. 1967 21 p refs
(Contract Nonr-4752(00))
(TR-11; AD-654149) CFSTI: HC $3.00/MF $0.65

The purpose of this report is two-fold. When the separating boundary between two pattern classes is a hyperplane, the effects of positive and negative correlations (between the variables used to construct the hyperplane) on the probability of misclassification are investigated. Secondly, a method for including or rejecting the variables in the hyperplane for a desired proportional gain at every stage is presented. Author (TAB)

N67-33721# California Univ., Berkeley. Operations Research Center.
INEQUALITIES AND TOLERANCE LIMITS FOR s-ORDERED DISTRIBUTIONS
Michael J. Lawrence Nov. 1966 61 p refs
(Contract Nonr-3656(18))
(DRC-66-37; AD-654154) CFSTI: HC $3.00/MF $0.65

Define F < (subscript s) G F < (subscript r) G if F and G have the same median, say the origin and G (superscript -1) F(x) is concave-convex about the origin (G (superscript -1) F(x)/x is increasing (decreasing) in x positive (negative)). Conservative tolerance limits are derived for distributions which are s-ordered with respect to the Laplace distribution. These are especially reasonable for mensuration data. In addition, many inequalities concerning combinations of order statistics are obtained. These results are useful in robustness studies of tolerance limits, estimates and statistical tests derived for specified distributions such as the normal distribution. Some examples are given. Author (TAB)

N67-33733# Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF GAME ENCOUNTER OF MOVEMENTS
N. N. Krasovskiy 12 Jun. 1967 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 173, no. 3, 1967 p 535–537
(JPRS-41351; TT-67-31985) CFSTI: HC $3.00/MF $0.65

Time required for leading and following movements is considered for differential game encounter problems with certain controls and limitations. The solution of the problem becomes one in optimal control, and so-called rules of extreme aiming are discussed. M.W.R.

N67-33734# Joint Publications Research Service, Washington, D. C.
GENERALIZED SOLUTION OF DIFFERENTIAL GAMES OF SURVIVAL
L. A. Petrosyan 21 Jul. 1967 15 p refs Transl. into ENGLISH from Ekonomika i Mat. Metody (USSR), v. 3, no. 3, 1967 p 420–425
(JPRS-41926; TT-67-32557) CFSTI: HC $3.00/MF $0.65

A class of equivalents in Helley metrics is used to define a differential game, which is a multistep process with continuous time in which each of the participants controls the changing position of a variable according to his own interests. Although differential games of survival are considered, the results are considered applicable to all differential games with integral payoff. M.W.R.

N67-33854# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
SMOOTHING BY MEANS OF FUNCTIONS ANALOGOUS TO SPLINE FUNCTIONS [LISSAGE PAR UTILISATION DE FONCTIONS ANALOGUES AUX FONCTIONS SPLINE]
Claude Ferrand 1967 19 p refs In FRENCH; ENGLISH summary Presented at the 6th A.F.I.R. Congr., Nancy, France, 22–24 May 1967
(ONERA-TP-483(1967)) CFSTI: HC $3.00/MF $0.65

The case of an infinite number of experimental values, is treated. The method also gives the adjustment of linear functionals such as the derivatives of any order in any point. An appropriate choice of the regularity and repeatability criteria allows assimilating the parameters of the linear form concerning a given problem to the discretization of a function L which is easily determined. This function L is also at the base of an interpolation process by means of functions analogous to Spline functions but formed with arcs of complex exponential functions. Author (ESRO)

N67-33872# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SIMULTANEOUS TESTS FOR THE EQUILITY OF COVARIANCE MATRICES AGINST CERTAIN ALTERNATIVES
P. R. Krishnaiah Mar. 1967 19 p refs
(ARL-67-0044; AD-653968) CFSTI: HC $3.00/MF $0.65

The paper considers the problem of testing for the equality of covariance matrices against certain alternatives when the underlying populations are multivariate normal. The alternative hypotheses considered are at least one covariance matrix is not equal to the covariance matrix of the next population, at least one covariance matrix is not equal to the covariance matrix of the standard population and at least one covariance matrix is not equal to the covariance matrix of another population. Author (TAB)

N67-33952# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
RECURRENT RELATIONS FOR THE MULTIPLICITIES OF WEIGHTS AND FOR THE MULTIPLICITIES OF REPRESENTATIONS OF A COMPLEX SEMISIMPLE LIE ALGEBRA
A. U. Klimyk 1966 24 p refs
(NP-16680)

A recurrent relation for the multiplicities of the weights of finite-dimensional irreducible representations of a complex semisimple Lie algebra which allows one to compute these multiplicities comparatively easily is derived. NSA

N67-33997# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON GENERALIZED FUNCTIONS
Saad K. Nasr 11 Apr. 1967 8 p refs Transl. into ENGLISH from Usp. Mat. Nauk (Moscow), v. 20, no. 4, 1965 p 163–165
(Contract NOw-62-060-4-c)
(TG-230-T516; AD-652819) CFSTI: HC $3.00/MF $0.65

Let S sub lambda (x) = (K/lambda) exp (- lambda squared/lambda squared -x squared)) if the absolute value of x < lambda; otherwise, S sub lambda (x) = 0; S sub lambda dx = 1. The author defines a g-function as a series (phi sub n) of functions infinitely differentiable on the line such that limit as n approaches infinity, of (phi sub n) * S sub lambda (x) exists for every lambda > o, x > minus infinity but < + infinity. It is found that the g-functions are closely associated with the generalized functions of Temple. Author (TAB)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-32730# Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
WIND SHEAR AND BAROCLINICITY IN CROSS SECTIONS ALONG 80°W
Dorothy A. Stewart 15 Feb. 1967 98 p refs
(RR-TR-67-4; AD-652258) CFSTI: HC $3.00/MF $0.65

The distribution of wind shear from the surface to 25 kilometers along 80 deg west longitude in the northern hemisphere is examined and is compared with the distributions of the other meteorological parameters. Cross sections of the mean and standard deviation of wind shear and wind speed are presented for each month. Monthly mean cross sections of temperature and density are also given. Time sections of mean wind shear and mean wind speed are given for four stations. In all seasons, very large shears are found near the surface at all latitudes and near the tropopause in low and middle latitudes. Minimum shears are consistantly found near 5 kilometers. Largest wind shears in the upper troposphere at a station do not necessarily occur in the same season as maximum wind speeds. In the troposphere above the friction layer, and in much of the stratosphere, wind direction changes are of greater relative importance as an expression of baroclinicity in the summer than in the winter. Author (TAB)

N67-32758# American Meteorological Society, Boston, Mass.
RELATION BETWEEN THE NUMBER OF THUNDERSTORMS AND THE AMOUNT OF SFERICS THAT PRODUCE A FIELD STRENGTH GREATER THAN A GIVEN LEVEL [SVIAZ' MEZHDU KOLICHESTVOM GROZ. I CHISLOM ATMOSFERNYKH POMEKH, SOZDIAIUSHCHIKH NAPRIAZHENNOST' POLIA VYSHE ZADANNOGO UROVNIA]
K. N. Barkalova Bedford, Mass., AFCRL, Apr. 1967 6 p ref Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 85–88
(Contract AF 19(628)-3880)
(T-R-574; TT-67-62076; AD-653172) CFSTI: HC $3.00/MF $0.65

The relation between the number of thunderstorms over the European continent and the amount of sferics that create a field strength greater than a given level is examined. The sferics were recorded in Voyeykovo and Odessa. Author (TAB)

N67-32841# American Meteorological Society, Boston, Mass.
EXPLANATION OF THE CAUSES OF NON-CORRESPONDENCE OF SFERICS CENTERS AND WEATHER CONDITIONS [VYIASNENIE PRICHIN NESOOTVETSTVIIA OCHAGOV ATMOSFERIKOV S POGODNYMI USLOVIIAMI]
N. I. Leushin Bedford, Mass., AFCRL, Apr. 1967 18 p Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 157, 1964 p 76–84
(Contract AF 19(628)-3880)
(T-R-573; TT-67-62077; AD-653173) CFSTI: HC $3.00/MF $0.65

Data of 1962 were used to calculate the percentage of sferics centers confirmed by weather conditions with respect to the total number of centers detected by radio direction finders, as a function of the level of activity of the centers and their distance from the direction-finding stations. Author (TAB)

N67-32878# Weather Squadron (12th). Detachment 12, Otis AFB, Mass.

STUDY OF RAIN VERSUS SNOW AT OTIS AIR FORCE BASE DURING THE WINTER SEASON OF 1966–1967

Henry Emile Forcier 26 Apr. 1967 25 p

(AD-653187) CFSTI: HC $3.00/MF $0.65

The thickness patterns 1000 - 850 MB, 1000 - 7000 MB, 1000 - 5000 MB for the winter season 1966 - 1967 were investigated using the ACK sounding plus temperatures at the 850 and 700 MB level to determine the possibility of the occurrence of snow and/or rain at Otis AFB. Furthermore, consideration was given to the precipitable water values from Nantucket and compared with the recorded water amounts at Otis. During the winter season 1966 - 1967 twenty-five case studies were investigated. Results are very promising. Graph C, 1000 - 700 MB Thickness vs 850 MB Temperature indicates the possibility in determining the state of the precipitation on a six-hour forecast basis at Otis AFB. Author (TAB)

N67-32957# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

COSMIC RAY PRODUCED RADIONUCLIDES AS TRACERS OF ATMOSPHERIC PRECIPITATION PROCESSES

N. A. Wogman, C. W. Thomas, J. A. Cooper, R. J. Engelmann, and R. W. Perkins 6 Mar. 1967 12 p refs Presented at the Am. Meteorol. Soc. Meeting, Ann Arbor, Mich.

(Contract AT(45-1)-1830)

(BNWL-SA-1146; CONF-670310-1) CFSTI: HC $3.00/MF $0.65

Cosmic ray-produced ^{34m}Cl, ^{38}Cl, ^{39}Cl, ^{38}S, and ^{24}Na were measured in rain and snow and their absolute concentrations determined. Absolute concentrations are related to the scavenging efficiency and the altitude from which precipitation occurred while relative concentrations provide information on the time spent by the raindrops subsequent to nucleation in the cloud but prior to deposition at the earth's surface. NSA

N67-33094# Wisconsin Univ., Madison. Dept. of Statistics.

MODELS FOR PREDICTION AND CONTROL. VIII: FORECASTING SEASONAL TIME SERIES

G. E. P. Box and G. M. Jenkins (Lancaster Univ.) Feb. 1967 69 p refs

(Grant AF-AFOSR-1158-66)

(TR-104; AD-650277) CFSTI: HC $3.00/MF $0.65

The object of this chapter is to consider appropriate stochastic models for seasonal time series and to consider how the appropriate model can be (a) identified, (b) fitted, (c) how the adequacy of the fit can be checked, and (d) how the appropriate model can be used for forecasting. TAB

N67-33113 Joint Publications Research Service, Washington, D. C.

EXPERIMENTAL RESEARCH ON TURBULENCE IN THE GROUND SURFACE LAYER

L. V. Dubrovin *In its* Collection and Interpretation of Meteorol. Data 28 Jun. 1967 p 9–21 refs (See N67-33111 19-04)

Results of an experimental verification of a system of computing the turbulence coefficient, suggested by the author and explained in previous references, are adduced. The present research was undertaken to check the system under extreme conditions of either the stability or instability of the temperature stratification. Computed values of the heat balance components for both conditions, are tabulated. The values agree well with experimental measurements. L.S.

N67-33326# Travelers Research Center, Inc., Hartford, Conn.

RELATIONSHIPS BETWEEN TROPICAL PRECIPITATING AND KINEMATIC CLOUD MODELS Annual Report, 1 Nov. 1966–30 Apr. 1967

G. Arnason and R. S. Greenfield Jun. 1967 85 p refs

(Contract DA-28-043-AMC-02192(E))

(Rept.-7482-257; AR-1; ECOM-02192-2; AD-654129) CFSTI: HC $3.00/MF $0.65

The mathematical formulation and associated finite-difference approximations for the numerical model of a precipitating roll cloud are summarized. With that background, the computer program used to perform the computations in experiments simulating moist convection is described in detail. The program description includes discussion of the input requirements, the internal operations, and the output. The newly developed recovery feature of the program is explained. All options, presently available in the program, are described. The detailed description of the computer program is contained in individual flow diagrams of the main program and the 16 subroutines. In the concluding remarks, the present status of the computer program is given. Finally, the anticipated future plans for the program are outlined. Author (TAB)

N67-33402# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE CHARACTERISTICS OF ATMOSPHERIC PROCESSES ON DAYS WITH A LOW CLOUD COVER

K. G. Abramovich 28 Mar. 1967 30 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Kristallografii Rost Kristallov (Leningrad), no. 136, 1965 p 12–24

(FTD-MT-66-23; AD-653509) CFSTI: HC $3.00/MF $0.65

The low cloud cover is considered in different synoptic processes, the objective evaluation of which is accomplished with the aid of the quantitative characteristics of the transfer rates, advective changes in temperature and humidity, vertical motions, turbulence and also local pressure changes. The differences in the values of indicated parameters make it possible to separate three main groups of processes that are also distinguished by certain properties of the lower layer of the atmosphere, in which there occurs formation of the lower-layer cloud cover. Author (TAB)

N67-33523 Joint Publications Research Service, Washington, D. C.

STUDIES IN SYNOPTICS

A. I. Voyeykov 15 Jun. 1967 54 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 198, 1966 p 30–42, 89–106, 160–167 CFSTI: $3.00

(JPRS-41405; TT-67-32093)

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3. CINEMIZING SYNOPTIC PROCESSES AS A METHOD OF INVESTIGATION IN SYNOPTIC METEOROLOGY V. M. Mikhel' p 40–47 (See N67-33526 18-20)

N67-33524 Joint Publications Research Service, Washington, D. C.
INTERLINKING ATMOSPHERIC PROCESSES AND SOLAR ACTIVITY
Ye. V. Vorob'yeva *In its* Studies in Synoptics 15 Jun. 1967 p 1–17 refs (See N67-33523 19-20)

Changes in the intensity of zonal circulation in the American–Atlantic part of the northern hemisphere in connection with the 27-day and 11-year cycles of solar activity are examined. Shown is the development of active longitudes of the sun in the interlinking of atmospheric processes of the American–Atlantic and Atlantic–European sectors. Reasons are presented for the stimulating role of solar activity in changes in intensity in the American–Atlantic sector, consequences of which to a certain degree are the circulation characteristics in the Atlantic–European sector. Author

N67-33525 Joint Publications Research Service, Washington, D. C.
THE POSSIBLE ROLE OF COSMIC RAY PARTICLES IN SOLAR-TROPOSPHERIC RELATIONS
B. I. Sazonov *In its* Studies in Synoptics 15 Jun. 1967 p 18–39 refs (See N67-33523 19-20)

In recent years, considerable effort has been expended on finding a possible mechanism by means of which disturbances from the sun are transmitted to the lower dense layers of the atmosphere. However, the suggested mechanisms did not provide the opportunity to explain a whole series of facts which are known from observations. Possibilities for constructing a mechanism for transmitting disturbances to the dense layers of the atmosphere by means of high-energy particles modulated by magnetic fields of solar corpuscular streams are presented. Discussed is the role of solar cosmic rays as well as of high-energy particles of the earth's inner radiation belt as intermediaries in solar-tropospheric relations. Author

N67-33526 Joint Publications Research Service, Washington, D. C.
CINEMIZING SYNOPTIC PROCESSES AS A METHOD OF INVESTIGATION IN SYNOPTIC METEOROLOGY
V. M. Mikhal' *In its* Studies in Synoptics 15 Jun. 1967 p 40-47 (See N67-33523 19-20)

A method for the visual showing of atmospheric processes—droughts, storms, and others, general circulation of the atmosphere, the evolution of cloud systems, their zones of precipitation—is presented. It consists of the cinemizing of synoptic processes by creating motion picture cartoons using color motion picture photography of a large successive series of synoptic charts of the Northern Hemisphere. Author

N67-33592 International Geophysical Year World Data Center A, Asheville, N. C. National Weather Records Center.
METEOROLOGICAL ROCKET NETWORK FIRINGS, VOLUME III, NO. 9 Data Report
Sep. 1966 223 p
GPO: $3.00

Wind and temperature measurements from all available meteorological sounding rocket firings for September, 1966 are tabulated along with computed values for pressure, density, and speed of sound. Included are data on the rocket type, type of wind and temperature sensors, and the local radiosonde observations nearest the time of firing. C.T.C.

N67-33601* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
SHORT RANGE RESEARCH
In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 62–79 refs (See N67-33601 19-10)

Short-range research on electric power systems and electromechanical energy conversion are briefly detailed. Research was directed toward: load weather forecasting, three-phase distribution circuit analysis, distribution network analysis by statistical theory, reliability analysis of distribution circuits, methods of generation scheduling, power plant and power system dynamics, and the identification of energized shielded cables. R.U.

N67-33661# Massachusetts Inst. of Tech., Cambridge.
APPLICATION OF RADAR TO MEASUREMENT OF SURFACE PRECIPITATION Semiannual Report, 1 Sep. 1966–31 Mar. 1967
Pauline M. Austin May 1967 21 p
(Contract DA-28-043-AMC-01472(E))
(Rept.-3; ECOM-01472-3; AD-654127) CFSTI: HC $3.00/MF $0.65

Installation of two new radars operating at 10 cm with a 1.3 degree beam and at 3.2 cm with a 1 degree beam has been completed. They are equipped with logarithmic receivers, pulse integrators, and sweep integrators for quantitative observations. In the investigation of precipitation patterns in various storm types, a study has been made of the structure of thunderstorms in a squall line and also of scattered air mass thunderstorms. Structure and behavior of precipitation associated with coastal cyclones is being analyzed in detail. All available drop size data from sections of the east coast between New England and North Carolina are being scrutinized for the purpose of selecting individual storms which have drop size characteristics significantly different from the average. Author (TAB)

N67-33842# Wisconsin Univ., Madison. Dept. of Statistics.
MODELS FOR PREDICTION AND CONTROL. VIII. FORECASTING
G. E. P. Box and G. M. Jenkins Feb. 1967 66 p refs
(Grant AF-AFOSR-1158-66)
(TR-103; AD-650276) CFSTI: HC $3.00/MF $0.65

The article discusses the problem of forecasting using a linear stochastic model appropriate to represent a given time series. The development uses non-seasonal time series for illustration. The articles proceed on the basis that the model is known exactly. In practice the coefficients actually being used will contain errors of estimation. Estimation errors can be ignored since they will not seriously effect the forecasts unless the number of data points, on which the fit is originally based, is small. The minimum mean square error forecasts may be generated very easily from the difference equation which defines the model. A further recursive calculation yields the probability limits for the forecasts. From the point of view of practical computation of the forecasts, the methods based on the difference equation are much easier than other methods. However, to provide insight into the nature of the forecasts generated by the difference equation, two further methods of generating the forecasts are discussed. These are (a) The integrated form where the difference equation is solved explicitly in terms of mathematical function such as polynomials whose coefficients can then be updated as each new observation comes to hand. (b) A form where the forecasts are expressed as a weighted average of past values of the series. Author (TAB)

N67-33912# Emmanuel Coll., Boston, Mass. Oriental Science Library.
A PRELIMINARY STUDY OF THE FLUCTUATIONS OF THE MICROPHYSICAL STRUCTURE OF CLOUD AND FOG IN HENG SHAN
Xu Huan-bin Bedford, Mass., AFCRL, Apr. 1967 21 p refs Transl. into ENGLISH from Chi Hsiang Hsueh Pao (Peking), v. 34, no. 4, Nov. 1964 p 539–547
(Contract AF 19(628)-50783)
(EMM-66-130; AD-653971) CFSTI: HC $3.00/MF $0.65

The paper studies experimentally the fluctuations of the absolute total concentration of cloud and fog droplets in a natural environment and the spectral profile of cloud drops by means of the continuous sampling technique. It is shown that the cloud drop concentration in the middle and lower regions of stratocumulus exhibit fluctuations with a spatial scale of 1 - 6 meters and that the values of these fluctuations may reach 30 - 100%. Fluctuations in the profiles of the cloud drop spectra are related to variations in concentration. Within the scale of fluctuations, the cloud drop spectra are characterized by the abundance of small droplets in regions of low concentration and large drops in regions of high concentration. Even under the conditions of uniform concentration over a broad range, fluctuations in the droplet spectra could still occur in a small volume because of the stochastic nature of the distribution and dispersion of cloud drops. This type of fluctuation becomes very small in samples of more than 1,000 - 2,000 drops. Author (TAB)

N67-33968*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON CLOUD MAPPING BY THE METEOROLOGICAL SATELLITES NIMBUS I AND NIMBUS II
G. Kuers Jul. 1967 37 p refs
(NASA-TM-X-55873; X-662-67-337) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Dense cumulus clouds and fog banks have been selected to determine mean values of their reflectances by means of the high resolution radiometers of Nimbus I and Nimbus II in the wavelength region between 3.6μ and 4.2μ. While both instruments yielded satisfactory results during nighttime, it became apparent that Nimbus I delivered too high reflectance values during daytime. From that it was concluded that false shortwave radiation entered the radiometer. The amount of the energy difference was used to determine the most probable cause of malfunctioning which was considered to be an uncoated rim or a crack of the interference filter. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-33356 Micro-Radionics, Inc., Van Nuys, Calif.
LOW COST CAPTURE EFFECT GLIDE SLOPE AMPLITUDE AND PHASE CONTROL UNIT Final Report
Jack Catran and Michael A. Midwin 10 Aug. 1966 28 p
(Contract FA65WA-1213)
(FAA-RD-66-58)

Reported are results of a study focusing on the design, development, production, and testing of a low cost capture effect glide slope amplitude and phase control unit for the Federal Aviation Agency. The primary objective was to develop equipment which would operate in the 328 mc to 336 mc glide slope band; accept, combine, and mix signals from three different sources into the appropriate phase and amplitude relationship; and deliver the signals to three FAA supplied glide slope transmitting antennas. The objectives of the program were achieved. A prototype model of the low cost capture effect glide slope amplitude and phase control unit was produced and delivered. Each parameter was well within performance tolerances, assuring that manufacturing, processing, and handling of the equipment will maintain its performance qualities without degradation. The final unit, simple in concept and logical in design, also established the success of the low cost objective. The design does not require close tolerances in machining and the number of different parts was kept to a minimum by the application of standardization and interchangeability techniques. Because the delivered equipment and its components have the inherent performance capabilities required to successfully meet all the specified criteria, it is recommended that no changes be made. The performance of the equipment has demonstrated that the low cost, reliability, and performance goals of the program have been attained and also provides assurance of high performance and reliability under storage, handling, shipping and parts interchangeability conditions. S.C.W.

N67-33357# Federal Aviation Agency, Atlantic City, N. J. National Aviation Facilities Experimental Center.
JAMESTOWN VOR LOCALIZER (VORLOC) Interim Report
Frederick W. Marscall Nov. 1966 21 p *ref*
(FAA-RD-66-90)

Presented are results of a limited technical performance evaluation of a low cost system called VORLOC which focused on the potential of this type of facility for low density airports. The equipment was tested at the National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey. Following the NAFEC tests, the equipment was subjected to more severe siting conditions to determine the degree to which course quality would be derogated. Jamestown, New York was selected as a typical small airport with reasonably difficult terrain features. Results of these tests were comparable to those obtained at NAFEC. The course line had course path bend amplitude of 0.46 degrees on a 95% probability basis with extremes of 0.23 and 0.90 degrees. Both front and back courses had a range of more than 25 miles at an altitude of 1,500 feet. The characteristics of the VOR TO–FROM indicator reversed sensing outside ±30 degrees of arc (approximately) from the on-course line were observed; however, the operational significance of this flag behavior was not established. Specifications for the application of localizer course/glide path bend amplitudes are included. It is recommended that a review be made of the operational impact of the TO–FROM flag sensing reversals with respect to operational safety and nuisance factors. In addition, it is recommended that the value of this facility be assessed on a comparative basis with other potential equipments being considered to satisfy the same general requirement for low cost facilities prior to any further development or testing activity. S.C.W.

N67-33458*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MANUAL ABORT GUIDANCE TECHNIQUE WITH CONCENTRIC-FLIGHT-PLAN RENDEZVOUS
G. Kimball Miller, Jr. and L. Keith Barker Washington, NASA Aug. 1967 47 p refs
(NASA-TN-D-4089) CFSTI: HC $3.00/MF $0.65 CSCL 17G

An analytical investigation has been made of a manual technique based on two periods of constant thrust-angle thrusting to abort the landing phase of the manned lunar mission. The abort initiation technique requires only an optical device for measuring the angle between the landing module thrust axis and the line of sight to the orbiting command module and a stopwatch. The results of the investigation indicated that standard abort orbits with pericynthion altitudes of approximately 50,000 feet (15,240 meters) and apocynthion altitudes of about 770,000 feet (234,696 meters) could be established for aborts from any point along the landing trajectory when the field of view in the pitch plane was unobstructed. To comply with window constraints typical of the Apollo landing module, it was necessary to accept nonstandard orbits for a range of abort initiation points. Although a fuel penalty is involved, the characteristic velocity capability remaining after

abort-orbit insertion in all cases exceeded 2000 ft/sec (609.6 m/sec). Thrust-angle errors of ±1.0° do not compromise the safety of the maneuver, the resulting orbits having pericynthion altitudes that exceed 30,000 feet (9144 meters). The established orbits are compatible with concentric-flight-plan rendezvous. Inherent in the technique, however, is the capability of performing a direct rendezvous from the first 383 seconds of the landing trajectory in the event that the time of abort initiation is not critical. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-32724# Isotopes, Inc., Westwood, N. J.
PROJECT STARDUST Progress Report, Oct. 1965–Sep. 1966
Herbert W. Feely, Charles S. Tucek, and David Katzman 31 Dec. 1966 110 p refs
(Contract DA-49-146-XZ-079)
(DASA-1905; PR-16; AD-652274) CFSTI: HC $3.00/MF $0.65

Work performed on Project Stardust during October 1965 to September 1966 is reviewed. The current sampling and analytical programs are summarized. Descriptions are given of the stratospheric distributions of strontium-90, manganese-54, cadmium-109 and carbon-14 from pre-1963 nuclear weapon tests, of plutonium-238 from the burnup of a SNAP-9A power source in April 1964, of daughter products of radon, and of fission products from the 9 May 1966 Chinese nuclear explosion. Recent measurements of carbon-14 in surface air in northern New Jersey are presented. Author (TAB)

N67-32766# Atomics International, Canoga Park, Calif.
RADIATOR CONDENSER DESIGN MANUAL
R. C. Smith, J. R. Crosby, E. A. Elliott, and R. D. Gallelly 1 Nov. 1966 173 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-12139) CFSTI: HC $3.00/MF $0.65

The design, analytical, and fabrication techniques used in the development of three types of radiator condensers for use on the SNAP II Mercury Rankine Program are presented. The successful testing of each type indicates the appropriateness of the techniques presented. The use of the manual for future radiator designs should aid in achieving an optimum design with a minimum expenditure of effort in the development phase of future programs. Author (NSA)

N67-32857# Naval Radiological Defense Lab., San Francisco, Calif.
GAMMA-RAY TRANSPORT PROPERTIES OF A CYLINDER PLACED BEHIND AND AXIALLY PERPENDICULAR TO A SLAB
G. E. Plummer and B. W. Shumway 11 Apr. 1967 65 p refs
(USNRDL-TR-67-42; AD-653079) CFSTI: HC $3.00/MF $0.65

A series of concentric annular zones on a steel slab were radiated serially by a fixed, point gamma-ray source. Exposure rate measurements were made behind the barrier along the normal from the source. Next a steel cylindrical partition was placed behind the barrier with its axis normal to the slab. This partition was in contact with the slab and concentric with the source detector axis. Exposure rate measurements along the axis were repeated. The two sets of measurements are presented and compared zone by zone to see what changes were brought about by the insertion of the partition. Author (TAB)

N67-32865# Los Alamos Scientific Lab., N. Mex.
ADVANCED PLUTONIUM FUELS PROGRAM Quarterly Status Report, Oct. 1–Dec. 30, 1966
24 Jan. 1967 74 p refs
(Contract W-7405-ENG-36)
(LA-3650-MS; QSR-2) CFSTI: HC $3.00/MF $0.65

The release of fission products to Na coolant from failed or deliberately vented reactor fuel elements is investigated. Methods of concentrating U, Pu, long-lived energetic γ emitting isotopes, and short-lived biologically hazardous isotopes at specific locations in the system are discussed. NSA

N67-32908# Nuclear Materials and Equipment Corp., Apollo, Pa.
RADIOISOTOPE POWERED CARDIAC-PACEMAKER PROJECT. TECHNICAL MEMORANDUM: PLATINUM PLATING ON COMPONENT PARTS
Andrew Recchia 6 Mar. 1967 15 p
(Contract AT(30-1)-3731)
(NUMEC-3731-4-5-4) CFSTI: HC $3.00/MF $0.65

Plating parameters have been established for depositing an adherent electroplate of Pt directly on Hastelloy C capsules. As an alternate procedure, a Ni flash electroplate was deposited prior to the Pt electroplate. The experimental hardness value of the Pt electroplate was compared with the hardness of the Pt anode material. A post plating treatment at 200°C was necessary to expel entrapped gases and moisture in the electroplate. Cross sectional examination indicated that a good mechanical bond exists between the Pt electroplate and Hastelloy C. For complete encapsulation of Hastelloy C with Pt, the established plating parameters were extended to barrel plating, which produced good bonding in the as-plated condition and in the 200° C heat treatment. However, thermal shock testing produced micro-blisters, which indicated spotty bonding of the electroplate to Hastelloy C. NSA

N67-32956# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
ZERO-POWER MEASUREMENTS ON A HIGH-FLUX DEMONSTRATION LATTICE
Albert E. Dunklee and Charles E. Jewell Apr. 1967 65 p refs
(Contract AT(07-2)-1)
(DP-1076) CFSTI: HC $3.00/MF $0.65

A Savannah River production reactor was loaded with a novel lattice capable of operation at neutron fluxes in excess of 6×10^{15} n/(cm^2) (sec). The high flux was attained by operating a relatively small number of fuel elements at very high specific powers to achieve maximum neutron production and by using a very light lattice to achieve long neutron lifetimes. The reactor control system was modified to compensate for fuel burnup and to provide optimum flux shaping. In preparation for this new loading, experiments were performed in the SRL exponential (SE) and critical (PDP) facilities to specify the lattice design, the fuel concentrations, and the control rod types and configurations for the high-flux loading. A number of additional experiments determined the following operating and safety characteristics: temperature coefficients, void coefficients, light water coefficients, and flux distributions. A final zero-power critical test was made on the production lattice prior to its insertion into the production reactor. Author (NSA)

N67-33008# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
BASIC NUCLEAR DATA FOR FAST REACTOR CALCULATIONS
M. Segev, S. Yiftah, and L. Gitter Nov. 1966 11 p refs Presented at the Conf. on Nucl. Data—Microscopic Cross Sect. and Other Data Basic for Reactors, Paris, 17–21 Oct. 1966 Sponsored jointly by EURATOM
(IA-1113; Conf.-661014-50)

The criticality factor, and the coolant loss and Doppler effects are examined for fast reactors. Given a certain specified accuracy needed in the calculated values of these reactor quantities, what is the corresponding required accuracy in the basic nuclear data used as input? The answer is obtained by using a group-diffusion code to get the corresponding accuracies in group parameters. The latter are interpreted in terms of accuracies in basic nuclear data. The required and available accuracies are compared, and it is found that both average cross sections and resonance parameters for a PuO_2–UO_2 core are insufficiently known. Author (NSA)

N67-33009# Los Alamos Scientific Lab., N. Mex.
CRITICAL MASS REDUCTION
George A. Jarvis and Carroll B. Mills 22 Mar. 1967 14 p refs
(Contract W-7405-ENG-36)
(LA-3651) CFSTI: HC $3.00/MF $0.65

Further study into the critical mass of nuclear reactors is outlined. Results of the study are presented. NSA

N67-33014# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
IN-PILE CORROSION OF NUCLEAR MATERIALS Quarterly Report, Jun. 1–Aug. 31, 1966
31 Aug. 1966 35 p refs
(Contract EURATOM-055-65-3 TEEB(RD))
(EURAEC-1784; EUR-3326; QR-5) CFSTI: HC $3.00/MF $0.65

In order to determine the effect of radiolysis of water on the electrochemical behavior of steel and Pt, systematic irradiation experiments with a Co source were carried out in acid solutions of ferrous and ferric ions, with additions of chlorides or alcohol or both. The radiolysis of these solutions was followed by recording the potential E_{Pt} of platinum versus an Ag/AgCl reference electrode during the after γ irradiation. Different types of (E_{Pt}-absorbed dose) diagrams were established, which showed potential increases and decreases, maxima and minima, depending on the experimental conditions. After thus following the radiolysis redox behavior, the open-circuit potentials of passivated and activated steel samples were measured as a function of time, (E_{SS}-time), in solutions irradiated up to particular points in the (E_{Pt}-dose) diagrams. A set of widely varying conditions in the solutions was thus obtained and the influence on the steel measured. Depending on these environmental conditions, activation of passive samples, passivation of active samples, and pitting phenomena were observed. Analyses of the irradiated solutions furnished information concerning the ions present at different irradiation stages. The strong reducing effect of organic impurities on, e.g., Fe^{3+} ions, during irradiation was demonstrated. These results together with literature data allowed an explanation of the main features of the (E_{Pt}-dose) curves: the platinum electrode functions either as an indicator for the available oxidation-reduction couples or as a hydrogen electrode, depending on the irradiation and "cooling" history of the solution. The (E_{SS}-time) curves were interpreted according to the aspect of the steel electrode after the test, which gave evidence of activation, passivation, and pitting. In addition, a start was made with potentiodynamic experiments which should at the end provide a complete explanation of the recorded variations of E_{SS} with time. Author (NSA)

N67-33050# Reactive Metals, Inc., Ashtabula, Ohio.
IRRADIATION TEST RESULTS ON CORES HAVING "AS-EXTRUDED" COARSE GRAIN
M. F. Garufi and C. A. Scharschu *In its* [Mark V-B Process Improvement, NPR Process Improvement, Basic Extrusion Tech.] 10 Oct. 1966 3 p (See N67-33048 19-15)

Coarse grain (duplex) structure was intentionally produced during extrusion of the Mark VE-I fuel element size, and irradiation tests were conducted to determine if coarse grain due to extrusion would prove detrimental to reactor performance. Primary objective was to ascertain if a set of parameters existed through which pressures could be reduced to alleviate production problems without adversely affecting the developed grain structure. It is reported that a direct correlation exists between the responses of both pressure and grain structure to the extrusion variables considered. M.G.J.

N67-33051# Reactive Metals, Inc., Ashtabula, Ohio. Extrusion Plant.
NPR BILLET FORGING REPORT U-319
E. J. Carozza *In its* Mark V-B Process Improvement, NPR Process Improvement, Basic Extrusion Tech. 10 Oct. 1966 13 p (See N67-33048 19-15)

Experiments were conducted to determine the feasibility of an extrusion upset-forging route as a means of producing nuclear power reactor (NPR) billets for co-extrusion instead of the conventional extrusion and machining method. Attention was focused on the effect of end unsquareness due to billet sawing, extruded billet wall variation, and billet to tooling clearances prior to forging upon the wall variation of the final forged billet. An analysis of the yields obtained demonstrates that an ingot to final billet yield of over 90% can be achieved on a production basis. Indications are that billet to good billet yields would approach 100% due to the self-salvaging characteristics of the forging process. M.G.J.

N67-33100# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
STEP PROJET Quarterly Technical Report, Apr.–Jun. 1966
K. A. Dietz, ed. Jan. 1967 164 p refs
(Contract AT(10-1)-205)
(IDO-17187) CFSTI: HC $3.00/MF $0.65

The SNAPTRAN-2 test program was the destructive test of a SNAP-10A reactor produced by the insertion of 5.1 dollars excess reactivity, which led to a 200 microsecond asymptotic period. Results of measurements of reactor kinetics are given with an interpretation of results. An outline of the mechanical results of the destructive test are given with a discussion of mechanical energy measurements. The radiological aspects of the test including instrumentation and measurements, ground testing program, and airborne activity testing are presented. The chemical and metallurgical post-test analyses are outlined and results which were obtained are given. The fuel pin and fuel element cannister design for the LOFT reactor are given. The reactor physics calculations for the fuel elements are discussed. The effects of a rod ejection incident are considered. Blowdown analyses, both calculated and measured, are given detailed consideration, as is meltdown analysis. Results of an extensive set of radiological measurements are given; these are analysed thoroughly. A description of the semiscale blowdown test program is given. NSA

N67-33119# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
APPLICATION OF THE JANVIER (M. YVON) METHOD TO PULSED NEUTRON EXPERIMENTS [APPLICATION DE LA METHODE JANVIER (M. YVON) AUX EXPERIENCES PAR NEUTRONS PULSES]
Valentin Deniz Dec. 1966 33 p refs In FRENCH
(CEA-R-3070)

For the analysis of pulsed neutron experiments, it is important to know the extrapolation length in order to be able to evaluate

the bucklings. For moderators in slab geometry, the method Janvier (M. Yvon) is very well adapted to the application of the boundary conditions. A study of the method is reported here as applied to the pulsed neutron problem and the Milne problem in the spectral case. It is shown that the first order approximation for the angular expansion is sufficient for obtaining a good value of the diffusion cooling coefficient, even though the ultimate precision depends on the method used to study the spectrum. An expansion of the spectrum in a series of Laguerre functions of order one is considered. In the $P_1+L_1^{(1)}$ approximation, the relative variation of the extrapolation length with buckling for light water is in good agreement with calculations made using the SLOP-1 code. For graphite, the variation is small in the buckling range interesting for experiments. The convergence of the Laguerre function expansion being very slow, a new system of orthogonal functions $t_n(\gamma)$ is proposed, which permits one to express the spectrum as a sum of Maxwellians, the set of Maxwellians chosen being defined by the free parameter s. The use of these functions with a conveniently chosen value of s could lead to rapid convergence. Author (NSA)

N67-33212# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

NIOBIUM CORROSION FLOWING LIQUID SODIUM BETWEEN 400 AND 600°C [CORROSION DU NIOBIUM PAR LE SODIUM LIQUIDE EN CIRCULATION ENTRE 400 ET 600°C]

Jacques Sannier, Louis Champeix, Raymond Darras, and Willy Graff Oct. 1966 31 p refs In FRENCH; ENGLISH summary (CEA-R-3028) CFSTI: HC$3.00/MF$0.65

The corrosion of niobium and two of its alloys has been studied under temperature, rate of flow and purity conditions of liquid sodium similar to those likely to occur in a fast neutron reactor. The results obtained are discussed with reference to the following parameters: purification method used for the sodium, temperature, metallurgical condition of the structural metal. Generally speaking, an important role is played by the oxygen content of the liquid metal towards the corrosion of the niobium. Although the metal behaves very satisfactorily when a hot trap purification is used, it undergoes corrosion in the presence of sodium which has been purified only by a cold trap. Author

N67-33239# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY Quarterly Progress Report, Oct.–Dec. 1966

Feb. 1967 51 p refs
(Contract AT(04-3)-189)
(GEAP-5427; QPR-7) CFSTI: HC$3.00/MF$0.65

The analysis of low-cycle fatigue as a failure mechanism was continued. A pattern for combining the uncertainty distributions by cause for each parameter (stress for example) into one distribution was studied, and a parametric study was conducted of the newly developed equation which enables calculation of the number of cycles of loading for crack growth through a pipe wall. Development of the PAPA (plate and panel analysis) program for stress and strain in pipes is nearly complete. Completed or in process are preprocessors for the elbow, reinforced 90-degree tee, and branch intersection (variable angle). Fracture toughness testing of small specimens is continuing with the preparation of Manjoine (WOL) specimens of 2-1/4 Cr–1 Mo steel. Burst testing of A-106B pipe was initiated with hydraulic pressurization to failure of an unflawed length of 6-inch Schedule 80 material. The initial determination of the effect of cycling rate on fatigue crack growth in A-212B steel at 600°F revealed that slower cycling (0.6 compared to 12 cycles /min) resulted in appreciably slower crack growth. Progress was made during the quarter in completing the prototype fatigue testing installation. Debugging and initial shakedown testing with light loading was conducted by deflecting the cantilevered end of a 20-foot pipe straight 1 to 2 in. to verify and calibrate strain gage output signals. NSA

N67-33240# General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.

ACCURATE NUCLEAR FUEL BURNUP ANALYSIS. Quarterly Progress Report, Sep.–Nov. 1966

B. F. Rider, C. P. Ruiz, J. P. Peterson, Jr., and F. R. Smith 1 Dec. 1966 86 p refs
(Contract AT(04-3)-189)
(GEAP-5403; QPR-12) CFSTI: HC$3.00/MF$0.65

The absolute Pu-239 thermal fission yields for stable Nd isotopes have been measured on a capsule containing highly enriched Pu-239 irradiated in the Materials Test Reactor for three cycles. The capsule was dissolved and analyzed by isotopic dilution mass spectrometry for the amount of each Pu and Nd isotope. The average Pu-239 thermal fission yields from three capsules analyzed to date for Nd-143, -144, -145, -146, -148, and -150 are given. A triple spike of U-233, Pu-242, and Nd-150 was calibrated for use in the determination of atom percent fission by isotope dilution mass spectrometry. Author (NSA)

N67-33266# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.

EXPERIMENTAL STUDY OF THE HYDRODYNAMIC INSTABILITIES OCCURRING IN BOILING-WATER REACTORS [ETUDE EXPERIMENTALE DES INSTABILITES HYDRODYNAMIQUES SURVENANT DANS LES REACTEURS NUCLEAIRES A EBULLITION]

Serge Fabrega (Ph.D. Thesis—Grenoble Univ.) 1966 119 p refs In FRENCH; ENGLISH summary
(CEA-R-2884)

An experimental out-of pile loop study of the hydrodynamic oscillations occurring in boiling-water reactors is discussed. The study was carried out at atmospheric pressure and at pressure of about 8 atmospheres, in channels heated electrically by a constant and uniform specified current. The study consists of 3 parts: 1) Preliminary determination of the laws governing pressure-drop during boiling. 2) Determination of the fronts at which oscillation appears, within a wide range of the parameters involved. 3) A descriptive study of the oscillations and measurement of the periods. Results are presented in a dimensional form, which is available, in first approximation, for all geometric scales and for all fluids. It was also observed that the wall thickness can be an important factor, and that oscillation can occur in a horizontal channel. Author

N67-33317# Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.

ENRICHMENT REQUIREMENTS FOR BONUS BOILER FEED FUEL AND REPLACEMENT SUPERHEATER FUEL, 1 OCTOBER 1965–31 DECEMBER 1966

Michael F. Valerino Feb. 1967 117 p refs
(Contract AT(40-1)-2674)
(CEND-295) CFSTI: HC$3.00/MF$0.65

Results of analyses performed to determine the feed enrichment of the BONUS boiler fuel and the enrichment of the replacement BONUS superheater fuel are presented. FLARE calculations—which treat burnup, fuel switching, and core geometry according to a one-group diffusion theory—will also minimize later calculations for refueling. Rough estimates of maximum-to-average power density ratio in the boiler and superheater are also made. Specifications of enrichment for an alternate superheater fuel assembly are also considered. NSA

N67-33329# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

THE CONCEPTUAL EVALUATION OF A FAST FLUX TEST FACILITY

E. R. Astley Apr. 1967 54 p refs Presented at Natl. Topical Meeting on Fast Reactors, San Francisco
(Contract AT(45-1)-1830)
(BNWL-SA-978; CONF-670413-1) CFSTI: HC $3.00/MF $0.65

An evaluation of the concept of the Fast Flux Test Facility is given. The final design is presented in detail. Each major point is discussed. (NSA)

N67-33331# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Sieberadorf. Reactorzentrum.
INFLUENCE OF LONG-TERM PLUTONIUM VALUE CHANGES ON FUEL CYCLE COSTS OF PLUTONIUM FUELLED REACTORS
H. Gruemm and P. Nathschlaeger 1967 19 p refs Presented at IAEA Symp. on Uses of Plutonium as a Reactor Fuel, Brussels, 17 Mar. 1967
(SGAE-RT-10/1967; CONF-670306-3)

Simplified condensed analytical expressions related to various reactor types are used to analyze fuel cycle costs of power reactors operating under conditions of changing fuel prices during station lifetime. The calculation methods are limited to conditions of linear price changes. The procedure is based on the present worth procedure and represents a simplification of the formula developed by H. Schmale. NSA

N67-33333# California Univ., Livermore. Lawrence Radiation Lab.
CONSIDERATIONS OF THE REFLECT OR EFFECT IN THE PULSED NEUTRON PROBLEM
Edward Garelis 27 Mar. 1967 14 p refs Presented at the Intern. Conf. on Res. Reactor Util. and Reactor Math., Mexico City, 2–4 May 1967 Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-70366; CONF-670501-9) CFSTI: HC $3.00/MF $0.65

The time-dependent Green's function for a reflected slab reactor is solved by using a simple one-group diffusion theory model. A better understanding of pulsed-neutron measurements for reflected systems was obtained. In the case of large reflectors the response appears to have a finite number of prompt decay constants. However, the results show that the prompt decay constants are determined by the system as a whole, and it is somewhat meaningless to ascribe separate decay constants to the core and reflector. The simple asymptotic period measurements yield reactivity values that are in close agreement with reactivity values that result from a static calculation. The reactivity calculated from a prompt decay measurement, k_1^1, is slightly larger than the reactivity calculated from an asymptotic period measurement, k_2^1; that is $k_1^1 > k_2^1$. Numerically, for a light-water assembly that is about 3 dollars subcritical, there exists about a 4% difference between the two reactivities when compared in units of (1–k). Author (NSA)

N67-33345# Oak Ridge National Lab., Tenn.
BEHAVIOR OF IODINE IN AIR—A RESUME OF THE FIRST SEVEN RUNS CONDUCTED AT THE NUCLEAR SAFETY PILOT PLANT
J. L. Wantland and T. H. Row Apr. 1967 115 p refs
(Contract W-7405-ENG-26)
(ORNL-4050) CFSTI: HC $3.00/MF $0.65

Tests were conducted at the Nuclear Safety Pilot Plant to investigate the transport behavior of I_2 in air. A limited amount of data on UO_2 transport was also obtained. Since no preferential retention of UO_2 on deposition coupons was observed, we conclude that retention of I_2 was completely independent of the retention of UO_2. Also it is implied that their general transport behaviors were independent. The UO_2 aerosol generated by the plasma torch in these tests was shown to be quite similar to the aerosols produced by arc-image-furnace melting, centered-W resistor melting, and in-pile nuclear melting. Fallout samplers showed an initial rapid decrease of fallout followed by a period of low fallout rate. Operation of the circulating fan for a short period of time at the beginning of a run effectively distributed the aerosol in the containment vessel and slowed down the rate of concentration decrease in the containment vessel. Author (NSA)

N67-33393# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
CHARACTERIZATION AND PRODUCTION OF U_3O_8 FOR THE HIGH FLUX ISOTOPE REACTOR
W. J. Werner and J. R. Berkman Apr. 1967 38 p refs
(Contract W-7405-ENG-26)
(ORNL-4052) CFSTI: HC $3.00/MF $0.65

The preparation and characterization of U_3O_8 used in the Oak Ridge National Laboratory HFIR fuel plates are described. The high performance required for the fuel plates demands uniformity of fuel distribution, and so nondestructive techniques were developed to detect and evaluate changes in fuel loading. Commercial oxide suffered severe comminution during plate fabrication and thereby biased plate homogeneity inspection. This factor plus the absence of irradiation data on this differing material under HFIR burnup made the use of such an oxide questionable. Morphology, microstructure, and behavior in plate fabrication are compared for a commercial oxide and an oxide manufactured at Y-12. The Y-12 oxide manufacturing process consists of peroxide precipitation from $UO_2(NO_3)_2$ solution, calcining, and sintering. The propensity toward comminution during fabrication showed by commercial U_3O_8 is reflected by a surface area greater than 0.05 m^2/g, as measured by a static BET krypton-adsorption method. Consistent with this, the commercial U_3O_8 particles exhibited a large number of microcracks when observed under the microscope, while the Y-12 oxide particles were rounded and contained few cracks. Author (NSA)

N67-33412# Battelle Memorial Inst., Columbus, Ohio.
AN EVALUATION OF UC–PuC FOR SODIUM-COOLED FAST REACTORS
Richard A. Wullaert, Joseph M. Fackelmann, and Walston Chubb 13 Apr. 1967 30 p refs
(Contract W-7405-ENG-92)
(BMI-1799) CFSTI: HC $3.00/MF $0.65

Irradiation data reported in the literature through October, 1966, for UC and UC–PuC were analyzed with respect to the effects of temperature, burnup, composition, initial density, and other factors upon swelling and gas release. The relationship between temperature and either swelling or gas release appears to be exponential. Below 1000°C, the relationship between swelling and burnup is linear. Compositions containing free U metal show rates of swelling and gas release which increase in proportion to the amount of free metal. In the range of 90 to 100% of theoretical density, the available data show little or no effect of initial porosity upon the swelling or gas-release characteristics of UC and UC–PuC. The data, which were classified primarily on the basis of maximum centerline temperatures, show no additional effect of burnup rate on swelling. Compatibility data of particular interest to Na-cooled fast reactors are summarized. Data are presented showing that the mechanical effects of the reaction of UC with steam above approximately 150°C are different from the effects of the reaction of UC with water below this temperature. Author (NSA)

N67-33445*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONTROL OF A NUCLEAR REACTOR WITH A GASEOUS CONTROL SYSTEM
Harry W. Davison, Colin A. Heath, and Walter Lowen Washington, NASA, Aug. 1967 71 p refs
(NASA-TN-D-4093) CFSTI: HC $3.00/MF $0.65 CSCL 18E

A control system concept utilizing a neutron-absorbing gas, helium 3, was investigated for use with a water-moderated reactor. A static gas system is finely distributed throughout the reactor core to minimize flux depression effects by the control medium. Reactivity control is performed by controlled pressurization of the helium gas. Investigations have been performed in the areas of helium 3 containment and thermal and neutronic stability during operation. Although there is some probability that leaks could occur in the control system, the rate of loss of helium can be limited such that the reactor can be shutdown before it is damaged. Potential accident situations are limited by using flow restricting orifices in the system and by providing a positive water pressure seal on the control system. The possibility of positive power coefficients of reactivity with a gaseous poison system was examined. Power coefficients of reactivity can be made small, and in some cases negative, by careful design. Configurations of a control element with small temperature and density gradients and a distribution system that provides a negative power coefficient are presented. The concept of reactor control with helium 3 in metal control elements located in the moderator region appears feasible for the system investigated. Author

N67-33488# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

AQUEOUS DECLADDING AND DISSOLUTION OF PLUTONIUM RECYCLE TEST REACTOR FUELS. PART 1: PLUTONIUM-ALUMINUM ALLOY FUELS

W. W. Schulz Apr. 1966 20 p refs

(Contract AT(45-1)-1830)

(BNWL-204) CFSTI: HC $3.00/MF $0.65

Certain factors such as activation behavior, instantaneous dissolution rates, and off-gas composition were determined during dissolution of various PRTR Pu-Al alloys in HNO_3-$Hg(NO_3)_2$ solutions. Pu-Al alloys irradiated to 28 to 48% burnup of their initial ^{239}Pu content, as well as unirradiated Pu-Al alloys, were studied (in 0.002 to 0.02M $Hg(NO_3)_2$ solution) at HNO_3 concentrations as high as 4M. Irradiated material activated only in dilute (≈1M) HNO_3 solutions. A key property of irradiated PRTR Pu-Al alloys was that, after activation in dilute HNO_3 was achieved, concentrated HNO_3 could be added to the dissolvent to adjust its acidity to 4 to 6M without passivating the alloy. (Dissolution to 4 to 6M HNO_3 is desirable to reduce the amount of hydrogen in the off-gas and to achieve fast dissolution rates.) Advantage of this property was taken in defining an activation-dissolution procedure for use in the Hanford Redox plant. Author (NSA)

N67-33507# Atomics International, Canoga Park, Calif.

DESIGN, PERFORMANCE, AND ECONOMICS EVALUATION OF SODIUM-HEATED, MODULAR, SUPERCRITICAL, STEAM GENERATORS

D. F. Casey, ed., W. F. Anderson, C. P. Craig, Jr., G. A. Schneider, A. C. Williams et al. 31 Oct. 1966 71 p refs

(Contract AT(11-1)-GEN-8)

(NAA-SR-8508) CFSTI: HC $3.00/MF $0.65

An IBM 7090 digital computer heat transfer code for a supercritical, once-through, sodium-heated, steam generator was developed. A water-side fouling factor was determined, based on published data. Detail designs of 37-tube and 61-tube modular steam generators were completed. Designs showing the installation of the modules, including their interconnecting piping, supporting structures, etc., were completed and price estimates obtained. A re-evaluation of previous economic studies continued to indicate cost savings resulting from the use of supercritical steam conditions. Three other reports cover the development and test phase of the project. One pertains to the welding development, NAA-SR-8541; and the others, NAA-SR-8414 and NAA-SR-8415, pertain to the experimental stress programs. Author (NSA)

N67-33562# Sandia Corp., Albuquerque, N. Mex.

REENTRY THERMAL ANALYSIS OF THE SNAP-19/NIMBUS B/AGENA SYSTEM

Robert D. Klett Mar. 1967 134 p refs

(Contract AT(29-1)-789)

(SC-RR-66-2672) CFSTI: HC $3.00/MF $0.65

The reentry thermal analysis used to evaluate the need for AGENA destruct and generator eject systems on the NIMBUS B/SNAP-19 mission is presented. The initial configurations investigated were randomly tumbling generators, generators on the NIMBUS B, and the generators and the NIMBUS B on the AGENA, with and without the exit heat shroud. Initial conditions ranged from those associated with orbital decay to preorbital aborts caused by AGENA thrust termination. The results of this analysis indicate that nothing would be gained by using an eject system and that the need for an AGENA destruct system is marginal. Author (NSA)

N67-33622# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

AERODYNAMIC STUDY OF THE FLUID FLOW IN THE CHANNEL OF A REACTOR FILLED WITH INTERNALLY AND EXTERNALLY COOLED FUEL ELEMENTS [ETUDE AERODYNAMIQUE DE L'ECOULEMENT FLUIDE DANS UN CANAL DE REACTEUR CHARGE EN ELEMENTS COMBUSTIBLES ANNULAIRES REFOIDIS INTERIEUREMENT ET EXTERIEUREMENT]

Jean-Claude Rousseau Nov. 1965 57 p In FRENCH; ENGLISH summary

(CEA-R-2856)

A study is made of the problem of the flow-rate and pressure distributions along the length of two volumes, internal and external, bounded by a series of non-contignous annular elements placed along the channel axis. It is observed that the phenomenon can easily be represented by equations. The theoretical expressions observed are particularly simple when the distances between the elements are above a certain minimum value. The experimental work has made it possible to show that the theoretical formulation derived is valid with a very great accuracy. The experimental study has also been carried out in the case of a very small spacing between the elements. It has been possible to show in this case that the hypothesis made for deriving the theoretical expressions was perfectly justified. Author

N67-33646# Los Alamos Scientific Lab., N. Mex.

DTF-BURN: A MULTIGROUP TRANSPORT THEORY BURNUP PROGRAM WRITTEN IN FORTRAN-IV

Joseph J. Prabulos, Jr. 28 Apr. 1967 93 p refs

(Contract W-7405-ENG-36)

(LA-3671) CFSTI: HC $3.00/MF $0.65

The one-dimensional, multigroup transport burnup code, DTF-BURN, is described. Instructions for the use of the program are included, together with flow diagrams of the code, listings of certain subroutines, and the results of a test problem. The code can be used to compute the neutron flux distribution as a discrete-ordinates solution of the Boltzmann transport equation at the beginning of each specified time step. This calculated flux distribution is then used to determine the change in nuclide concentrations during the time interval. Nuclides considered in the burnup routine are U^{235}, U^{236}, U^{238}, Np^{239}, Pu^{239}, Pu^{240}, Pu^{241}, Pu^{242}, and FP, a pseudo fission product pair. The burnup differential equations may be applied to each region or to each point. Author (NSA)

N67-33663# Babcock and Wilcox Co., Lynchburg, Va. Nuclear Development Center.

PHYSICS VERIFICATION PROGRAM. Final Report

R. H. Clark, M. N. Baldwin, W. G. Pettus, T. G. Pitts, and R. B. Flickinger Mar. 1967 188 p refs
(Contract AT(30-1)-3647)
(BAW-3647-3) CFSTI: HC $3.00/MF $0.65

A program to determine the nuclear properties of water-moderated, slightly enriched, uranium dioxide lattices perturbed by clusters of Ag–In–Cd poison pins and dissolved boric acid is described. Core parameters and configurations typical of those in water-moderated power reactors were studied. The unperturbed basic lattice consisted of 0.475-inch-OD rods of 2.46%-enriched UO_2 on a square lattice pitch of 0.644 inch, and core radii varied from 19 to 65 cm. Boric acid, in concentrations from 0 to about 1500 ppM, was dissolved in the moderator to control excess reactivity. Power reactor fuel elements, incorporating clusters of Ag–In–Cd poison pins and typical structural material, were simulated in the central region of the largest core. Measurements were made of critical size, reactivity worth of poison pins, buckling, reflector savings, thermal disadvantage factor, epithermal absorption in ^{238}U, conversion ratio, neutron spectrum, radial and axial power distribution, and temperature coefficient. Experimental results of the program, many of which have been reported in quarterly technical reports, are presented. In some cases the data have been re-analyzed, and the reported results may differ slightly from those reported earlier. NSA

N67-33657# Bettis Atomic Power Lab., Pittsburgh, Pa.
NEUTRON LEAKAGE EFFECTS ON THE FAST ADVANTAGE FACTOR IN A SEED-BLANKET ASSEMBLY
S. S. Glickstein, J. W. Beck, L. L. Wheat, and W. J. Hall Apr. 1967 19 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-638) CFSTI: HC $3.00/MF $0.65

Fast advantage factor measurements and calculations have been performed in a single module seed-blanket assembly containing a ThO_2 blanket and a highly enriched uranium seed. Large variations were noted in the advantage factors which were attributed to leakage effects due to the narrow seed region and the varying fast neutron source distribution through the core. One group, two-dimensional Monte Carlo calculations, with the MARC program approximating the explicit core geometry, are in agreement with the measured results. Calculations were also performed applying the principles of superposition and reciprocity to illustrate the dependence of the fast advantage factor on neutrons originating from various sections of a core. Author (NSA)

N67-33663# Oak Ridge National Lab., Tenn.
SUBCRITICALITY MEASUREMENTS BY NEUTRON NOISE ANALYSIS
D. P. Roux [1966] 26 p refs Presented at Liquid Metal Instrumentation and Control Symp., Idaho Falls, Idaho
(Contract W-7405-ENG-26)
(ORNL-P-2979; CONF-670314-1) CFSTI: HC $3.00/MF $0.65

An analysis of the possible applicability of reactor noise to measure reactor parameters at subcritical levels is given. The feasibility of application in the LMFBR is investigated. Detector efficiency, equipment problems for higher break frequencies, and validity of approximation models are considerations given cursory analysis. NSA

N67-33681# United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group.
GAMMA AND NEUTRON FLUXES IN THE DOUNREAY FAST REACTOR
A. G. Edwards and H. Atkinson 6 Oct. 1966 22 p refs
(TRG-1429) CFSTI: HC $3.00/MF $0.65

The Dounreay Fast Reactor is operating as a fast flux materials testing reactor at a thermal power of 60 MW and centre flux of 2.5×10^{15} n/cm^2/sec. The values of γ and neutron fluxes throughout the core and inner breeder are required with greater precision for predicting rig conditions than they would be for operating the reactor as a power plant. Moreover experimental data must be obtained with minimum reduction in reactor load factor. The techniques and apparatus which have been adopted are described, and attention is drawn to the changed emphasis since the original commissioning experiments. Reactor modification has altered the flux profiles, and these are now explored using a minimum of spectrum-sensitive materials, and concentrating on speed and reliability of experimentation. Recently measured reaction-rate distributions are quoted for different rod configurations. A substantial attempt has been made to reproduce this information by calculation, and the progress of this work is described. It is concluded that none of the present data sets is really adequate for calculating DFR to the degree of accuracy required. Reference is made to work on γ heating rates in core and inner breeder. NSA

N67-33695# Oak Ridge National Lab., Tenn.
ESTIMATION OF RESONANCE EFFECTS IN FUEL BURNUP ANALYSIS
A. R. Olsen and J. W. Prados Mar. 1967 24 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1760) CFSTI: HC $3.00/MF $0.65

A computer program RCROSS, which calculates time-averaged thermal flux, resonance-to-thermal flux ratios and atomic percent heavy metal burnup for U fuels is described. The input data required are the irradiation time, the preirradiation and postirradiation U isotopic analyses for the fuel, and literature values for the various neutronic constants. Author (NSA)

N67-33698# Oak Ridge National Lab., Tenn.
UTILIZATION OF THE OAK RIDGE RESEARCH REACTOR TO STUDY THE MECHANISM OF FISSION-GAS RELEASE FROM REACTOR FUELS
R. B. Perez, R. M. Carroll, O. Sisman, and G. M. Watson [1967] 27 p refs Presented at Intern. Conf. on Res. Reactor Util. and Reactor Math., Mexico City
(Contract W-7405-ENG-26)
(ORNL-P-2978; CONF-670501-6) CFSTI: HC $3.00/MF $0.65

The parameters that control the release of fission gas during irradiation were examined. Complementary studies were conducted on pyrolytic-carbon-coated fuel particles to evaluate the integrity of pyrocarbon coatings during irradiation. Results are included on fission-gas release from UO_2 as affected by temperature and metallographic defects. Oscillation methods were used to test models evolved from the results. NSA

N67-33715# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.
ON THE SIGNIFICANCE OF ADJOINTED FLUXES IN REACTOR KINETICS [UEBER DIE BEDEUTUNG DES ADJUNTIERTEN FLUSSES IN DER REAKTORKINETIK]
E. A. Fischer Jan. 1967 37 p refs In GERMAN
(KFK-508)

The neutron flux was defined and its properties were described. The explanation was made within the framework of the multigroup-diffusion theory since the diffusion theory is sufficiently accurate for many practical calculations. The information on physical magnitudes that can be obtained from the solution of the adjoint equations was considered. It was shown that the reactivity and some other nonobservable magnitudes can be so described that they have the same values in both the general description and the adjoint description. A mixed description can be given which leads directly to the known variation method. The perturbation calculation for reactor rates can be derived directly from the mixed description. The adjoint description was made explicit for application to the problem of a reactivity step. NSA

N67-33724# Argonne National Lab., Ill.
ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 10: BENCH-SCALE STUDIES ON IRRADIATED, HIGHLY ENRICHED, URANIUM-ALLOY FUELS
A. A. Chilenskas, K. S. Turner, J. E. Kincinas, and G. L. Potts Oct. 1966 43 p refs
(Contract W-31-109-ENG-38)
(ANL-6994) CFSTI: HC $3.00/MF $0.65

A series of six experiments on irradiated uranium–Zircaloy and uranium–aluminum alloy fuels using fluid-bed fluoride volatility (FBV) processing techniques has been completed. These experiments were performed to determine the distribution of uranium and fission products following the various process steps and to indicate what decontamination factors can be realized. A hydrochlorination step was employed to remove the zirconium or aluminum from the uranium in the fluid-bed reactor. A fluorination step was employed (using fluorine) to volatilize the uranium as UF_6. A packed bed of granular alumina downstream of the fluid-bed reactor removed particulate matter entrained in the process gas, and beds of NaF pellets were used for additional decontamination. The retention of uranium in the reactor bed and the filter bed following the processing of irradiated uranium–Zircaloy or uranium–aluminum alloy was less than 1%, which is acceptable and comparable to that found in processing nonirradiated uranium alloys. Decontamination factors for the activities Ce, Sr, Cs, Ru, Sb, Zr, and Nb from uranium ranged from 3.5×10^5 to 1×10^8 for the final two experiments. The decontamination from gamma activity for these two runs was high and such that the principal gamma activity found with the product was due to ^{237}U. The decontamination factor for tellurium was 5.9×10^4; the factors for Mo, Tc, and Np were 44.6, 2.9, and 3.5, respectively. The distribution of fission products following hydrochlorination showed the principal volatile fission products to be Zr, Nb, Kr, and I. The activities that are only partially volatile (<10%) are Sb, Te, Mo, and Tc. The activities that are nonvolatile are Ce, Cs, Sr, and Ru. The distribution of the fission products following fluorination showed the highly volatile fission products to be Sb, Mo, Tc, Np, Nb, and Te. A small amount of zirconium was transported, probably by volatilization, from the reactor. The activities Ce, Cs, Sr, and Ru were essentially nonvolatile.
Author (NSA)

N67-33738# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
BEHAVIOUR OF IRRADIATED THERMOCOUPLES: EXPERIMENTAL INVESTIGATIONS
G. Bianchi, P. Lupoli, and S. Moretti 1966 23 p
(RT/ING/(66)-14)

Two experiments that were used to study radiation effects on thermocouples are described. In the first experiment, calibration was performed during irradiation at various power levels and at reactor shutdown, by means of an ideal reference thermometer placed within the rig. In the second experiment calibration was performed after irradiation in a hot facility. The materials used were Cr–Al, Fe, and Cr. The results demonstrated that no appreciable drift arises after an integrated neutron flux up to 10^{20} nvt in the thermoelectric characteristic of Cr–Al thermocouples, used in the temperature range up to 600°C.
Author (NSA)

N67-33739# Argonne National Lab., Ill.
MEASURED PHYSICS PARAMETERS IN A ZONED FAST URANIUM CARBIDE CORE, ASSEMBLY 4Z
R. A. Karam, A. Ancarani, F. H. Helm, W. Y. Kato, G. W. Mein et al Dec. 1966 48 p refs
(Contract W-31-109-ENG-38)
(ANL-7281) CFSTI: HC $3.00/MF $0.65

Assembly 4Z of 2PR-6 is a zones cylindrical core with a central region having the composition of a 2600-liter carbide core, assembly 5. Assembly 4Z is designed so that the neutron-energy spectrum and the importance spectrum at the center are the same as those for assembly 5. The major objective associated with the zoned core is to test, in conjunction with the full-scale system, how well reactor physics parameters for assembly 5 can be predicted from the zoned-core measurements.
NSA

N67-33752# Brookhaven National Lab., Upton, N. Y.
MEASUREMENTS OF THE NEUTRON BEAM CHARACTERISTICS IN THE BROOKHAVEN HIGH FLUX BEAM REACTOR
Eugene V. Weinstock Mar. 1967 28 p refs Presented at Intern. Conf. on Res. Reactor Util. and Reactor Math., Mexico City, 2–4 May 1967
(Contract AT(30-2)-GEN-16)
(BNL-112451; CONF-670501-5) CFSTI: HC $3.00/MF $0.65

The beam characteristics measured are associated with the thermal, epithermal, and fast neutron fluxes. Other characteristics measured are associated with the spatial distributions of neutron fluxes across the beam tube thimbles, effective neutron temperatures, and gamma fluxes. The measurements were performed at reactor powers up to 10 MW, but all reported results were scaled up to 40 MW.
NSA

N67-33775# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.
INVESTIGATION OF PROMPT NEUTRON KINETICS IN THE FAST-THERMAL ARGONAUT-REACTOR STARK BY NOISE ANALYSIS
M. Edelmann, T. E. Murley, and D. Stegemann Jan. 1967 34 p refs Presented at Am. Nucl. Soc., Coupled Reactor Kinet. Conf., College Station, Tex., 24–25 Jan. 1967
(KFK-522; CONF-670107-7) CFSTI: HC $3.00/MF $0.65

Even with a power fraction in the fast zone of 31% the coupling between the fast core and the annular thermal driver region was found to be very strong. A theoretical method for investigating coupled systems is described. It is essentially a modal expansion of the flux which permits a rigorous treatment, within the limits of multigroup diffusion theory, of the space and energy dependence of the prompt neutron flux as well as the location and spectral sensitivity of the neutron detectors. The fundamental, or asymptotic, decay mode and the important higher modes were found, and the calculated decay of prompt neutron chains was compared with that measured by noise techniques. The experimental techniques applied for these investigations were the Rossi-α method and the probability distribution analysis. A description of the electronic systems is given. Measurements have been performed in both the fast and thermal regions.
Author (NSA)

N67-33779# Martin Co., Baltimore, Md.
SNAP 19 GENERATOR HEAT DISTRIBUTION TEST AT MACH 8
R. C. Adams and C. A. Fluet Mar. 1967 178 p refs
(Contract AT(30-1)-3607)
(MND-3607-92, Vol. I) CFSTI: HC $3.00/MF $0.65

Heating data were obtained for three 30% scale models of the SNAP-19 generator. The three models having different fin spans (full, two-third and one-third span) were tested at the Von Karman Facility, AEDC Tunnel B Mach 8 with fixed pressure and temperature. The one-third span model was also tested to determine the effects of increased Reynolds number. The models were tested at roll angles of 0 and 30 degrees over the angle of attack (α) range of 0 to 90 degrees. Data obtained during the test were processed and presented for all thermocouples of each configuration and average heating rates for each thermocouple over a 90-degree angle of attack range. The data presented are sufficiently comprehensive and accurate to be used in a burnup analysis of the SNAP-19 generator during reentry. The precision of the data was

demonstrated by repeat runs to be within the reported accuracy. The results indicate that the average heating rates decreased on both the generator body and fins as the fin span decreased, i.e., during simulated fin disintegration. It was also observed that increasing the Reynolds number tends to increase the average heating rate on both the generator body and the fins. Author (NSA)

N67-33845# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.

PLUTONIUM–URANIUM MIXED OXIDE FUEL PALLET FABRICATION DEVELOPMENT FOR THE SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR

C. N. Craig, C. M. Ryer, and M. L. Thompson Oct. 1966 27 p refs

(Contract AT(04-3)-540)

(GEAP-5285) CFSTI: HC $3.00/MF $0.65

The process was developed to fabricate SEFOR-design PuO_2–UO_2 pellets with densities 85 to 98% theoretical. Geometric defects, such as end-dishing and hour-glassing typical of pellets fabricated by conventional methods, were minimized or eliminated through a prepressing step in powder preparation. The pellet quality was ascertained by uniform O/M ratio and density measurements made as a function of radius, as well as by final chemical analysis. The process was also used successfully to fabricate pellets with dished ends of controlled geometry. Author (NSA)

N67-33861# Société Belge Pour l'Industrie Nucléaire, Brussels (Belgium).

USE OF PLUTONIUM AS A FUEL IN NUCLEAR REACTORS Quarterly Report, 1 Jul.–30 Sep. 1966

Nov. 1966 75 p refs Prepared Jointly with Centre d'Etude de l'Energie Nucléaire, Mol, Belgium

(Contract EURATOM-001-64-1 TRUB)

(EURAEC-1774; QR-11; BN-6611-07) CFSTI: HC $3.00/MF $0.65

Fusion tests on UO_2 compressed into pellets in brass crucibles showed that there was no UO_2-brass reaction, and that the efficiency was of the same order of size as that obtained with the quartz crucible. A system of positioning the powder column by means of hollow crimped pellets with Poral discs was developed and used in fabricating forty rods for neutron tests. It appears that the vibration sequence is not the dominant factor in heterogeneous Pu distribution inside the rods. Results of investigations show that the oxygen content of mixed oxides can be determined by coulometry after dissolution in a mixture of $AlCl_3$–KCl. Contact gammagraphy inspection of 6 and 7 diameter rods with one generator is representative of the longitudinal activity distribution. Post-irradiation examination of the rods irradiated at about 800W/cm in the third series of irradiation tests in the hydraulic conveyor did not reveal any variations in size. Initial metallographic examination showed the appearance of grain sintering. Visual examination of the rods irradiated in the first boiling water capsule up to 10,000 MWd/t did not reveal any deformation, corrosion, or anomalies at right angles to the welds. Dimensional measurements did not show any deformation of the canning. Initial examinations on the BR-3/PWR rods did not reveal any variations in size. Theoretical work was chiefly concerned with calibrating and adapting the Cadilhac code used for calculating neutron spectra in the thermal region, and with interpreting the results of the pulsed sub-critical measurements effected on the Thetis fuel. Work was continued on adapting the VENUS critical facility. The starting data for the critical tests depends primarily on the time the grids are delivered and on solving the safety problems. An initial evaluation of the incidence of plutonium recycling in a PWR plant was started, using arbitrary data; it shows the need for relatively elaborate optimization. Author (NSA)

N67-33862# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.

THE MULTIGROUP DIFFUSION PERTURBATION ALTAC CODE FOR THE PHILCO-2000 COMPUTER

M. Lemanska and S. Yiftah Dec. 1966 20 p refs

(IA-1069)

PERDIF is a first order perturbation code based on the multigroup multiregion diffusion equation for spherical geometry. It is programmed for the Philco-2000 computer in ALTAC mnemonic language. The code may be used to calculate the change in k_{eff} obtained by perturbations of the material cross sections in a single region of a reactor. The fluxes and adjoint fluxes required by the perturbation formula are obtained by the DIFAL and DIFAD codes. Author (NSA)

N67-33863# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

KINETICS OF HETEROGENEOUS SYSTEMS [LA CINETIQUE DES MILIEUX HETEROGENES]

Valentin Daniz Jan. 1967 27 p refs In FRENCH

(CEA-R-3080)

A general transport theory treatment is presented for the kinetics study as applied to finite heterogeneous systems. The theory is applicable to experiments near the critical point as well as to pulsed neutron experiments on multiplying or non-multiplying lattices. The general method is also applied to exponential experiments on infinite non-diverging lattices. The particularity of the present study is the explicit introduction of heterogeneity in the formulation and the search for the dependence of the parameters on the buckling of the finite medium. As a result of this, the finite medium parameters are in the first place expressed in terms of the corresponding infinite medium ones through the buckling and the anisotropic migration areas, and in the second place all the parameters are expressed as integrals only over unit cell instead of over the whole pile. A preliminary less detailed study is first made in order to distinguish clearly between what are called "dynamic parameters" and "static parameters," and to define the meanings given in this report to these two terms. In the appendices are given approximate one-group treatments for the study of the dynamic fine structure, the time constant in infinite lattices, and the anisotropic diffusion coefficients in nonmultiplying lattices. Author (NSA)

N67-33877*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

HEAT AND MASS-TRANSFER CHARACTERISTICS OF AN AXIAL-FLOW LIQUID-CORE NUCLEAR ROCKET EMPLOYING RADIATION HEAT TRANSFER

Robert G. Ragsdale, Albert F. Kascak, and Leo F. Donovan Washington, NASA, Aug. 1967 48 p refs

(NASA-TN-D-4127) CFSTI: HC $3.00/MF $0.65 CSCL 21F

A liquid carbide fuel was supported on the inside surface of a rotating tube. The hydrogen propellant, seeded with radiation-absorbing seed material, flowed through the tube where it was heated by thermal radiation from a fissioning liquid fuel. Liquid-fuel surface temperature, uranium concentration in the fuel, tube length and diameter, and hydrogen flow rate were the primary variables. Calculations were made for both zirconium carbide and niobium carbide solvents in which uranium carbide was dispersed. The calculations show that the radiant heating produces a specific impulse somewhere between the lowest value of interest, 1300 seconds, and the maximum attainable, about 1600 seconds—a value that is only marginally higher than that provided by conduction heating of hydrogen bubbled through the liquid fuel. The ratio of hydrogen flow rate to uranium flow rate is likely to range from about 20 to 100, depending on what compromises are chosen in flow-rate ratio, reactor pressure, tube diameter, and thrust of core-weight ratio. When the other parameters are within

reasonable limits, the thrust to core-weight ratio is between 3 and 13. The surface temperature of the liquid fuel must be maintained between 9000° and 10,000°R in order to attain a specific impulse in the range of interest.

N67-33885# Brookhaven National Lab., Upton, N. Y.
HFBR START-UP EXPERIMENTS
Cesar A. Sastre Mar. 1967 6 p Presented at Intern. Conf. on Res. Reactor Util. and Reactor Math., Mexico City, 2–4 May 1967
(Contract AT(30-2)-GEN-16)
(BNL-11243; CONF-670501-4) CFSTI: HC $3.00/MF $0.65

Experiments were conducted to determine the effects of He coolant pressure changes on reactor vessel strains associated with core and control rod movements. Other tests were conducted to determine the effects on reactivity of uniform core and temperature changes, sample insertions in the irradiation facilities, and voiding the irradiation tubes. Checks of subcriticality in partially loaded core configurations were made. Measurements of Xe poisoning were made at 1, 3, and 37 MW. NSA

N67-33899# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
POWER REACTOR HIGH PERFORMANCE UO_2 PROGRAM Progress Report, Jul. 1–Oct. 31, 1966
W. H. Arit, N. H. Barth, E. A. Lees, M. E. Lyons, and D. T. Weiss Dec. 1966 51 p refs
(Contract AT(04-3)-189)
(GEAP-5402; EURAEC-1820; PR-1) CFSTI: HC $3.00/MF $0.65

Design efforts for the development of Zircaloy-2-clad UO_2 fuel rods for irradiation to varying degrees of central melting in an operating power reactor are reported. The results of thermal-hydraulic and physics analyses are given. NSA

N67-33908# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
THE DEVELOPMENT OF AN ACOUSTICAL THERMOMETER FOR A GRAPHITE MATRIX NUCLEAR FUEL ELEMENT
J. B. Roes and D. L. Peat 8 Oct. 1966 16 p refs Presented at the 13th Nucl. Sci. Symp., Boston, 19–21 Oct. 1966; Sponsored by IEEE Submitted for publication
(Contract AT(04-3)-167)
(GA-7413; CONF-661020-17) CFSTI: HC $3.00/MF $0.65

The development of an acoustical thermometer for use in graphite matrix nuclear fuel elements is described. Test results indicate that this thermometer accomplished the objective of automatically, accurately, and reliably recording temperatures of a number of sensors. The acoustical thermometer system offers a wider choice of signal transmission line and sensor materials than conventional thermometer systems, since it does not require the use of electrical insulators or the conductors in them. This advantage was the main reason for choosing the acoustical thermometer for use in the particular environment of interest. While the development of the thermometer was directly aimed at the solution of problems associated with a nuclear and carbonaceous environment, a number of observations are presented that should be pertinent to an acoustical thermometer design in general. Author (NSA)

N67-33909# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
SODIUM-COOLED REACTORS FAST CERAMIC REACTOR DEVELOPMENT PROGRAM Quarterly Report, Nov. 1966–Jan. 1967
Feb. 1967 89 p refs
(Contract AT(04-3)-189)
(GEAP-5433; QR-21) CFSTI: HC $3.00/MF $0.65

The Fast Ceramic Reactor Development Program is an integrated analytical and experimental program directed toward the development of fast reactors employing ceramic fuels, with particular attention to mixed PuO_2–UO_2. Developments are reported for studies on: vented fuel development; transient testing of fuels; fuel performance evaluation; fast flux irradiation of fuel; reactor physics and core analysis; and FCR cladding evaluation. NSA

N67-33916# Giessen Univ. (West Germany). Zweites Physikalisches Institut.
EXPERIMENTS WITH MASS SPECTROSCOPICALLY SEPARATED FISSION PRODUCT IONS [EXPERIMENTE MIT MASSENSPEKTROMETRISCH GETRENNTEN SPALTPRODUKTSTRAHLEN]
E. Konecny, H. Gunther, and G. Siegert Jan. 1967 39 p refs In GERMAN; ENGLISH summary
(BMwF-FBF-67-02)

With a mass spectrometer of the Mattauch–Herzog type at the Munich reactor, fission products can be separated according to mass and energy. The source is a 100 g/cm^2 U-235 layer in the neutron beam. Using this apparatus investigations were made on: the ionic charge of fission products as a function of kinetic energy and mass; the response of semiconductor surface barrier detectors to fission fragments; the fine structure in the mass yield of the thermal fission of U-235; and the primary nuclear charge distributions for separated masses and their dependence on kinetic energy. Author (NSA)

N67-33917# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR PHYSICS DEPARTMENT TECHNICAL ACTIVITIES Quarterly Report, Jul.–Sep. 1966
15 Oct. 1966 72 p refs
(Contract AT(45-1)-1830)
(BNWL-340) CFSTI: HC $3.00/MF $0.65

A recent revision in HRG (Hanford Revised Gam), a neutron slowing down code, modifies the calculation of the effective resonance integral of individual resonance by using for normalization an approximation to the flux used in the resonance integral calculation itself rather than a 1/E flux. A calculation study of thermalization within a simple cell has been made using the RBU Monte Carlo, THERMOS, and Program S-XIII codes. A comparison of the results shows the RBU Monte Carlo thermalization routine is formulated correctly and free from detectable numerical error. Experiments have been conducted in the PRCF using 2 wt % PuO_2–UO_2 fuel in H_2O. These experiments are directed towards determining the physics properties of Pu-fueled H_2O moderated reactor systems. Results are given for a two-zone critical experiment. Also given are results of measurements in a single-zone loading of fuel which contains 24 wt % ^{240}Pu. A calculation study of thermalization in PuO_2–UO_2 fueled H_2O moderated lattices has been performed. The purpose of the study is to determine whether errors are incurred in making assumptions pertaining to scattering processes, boundary conditions, and the source of thermal neutrons. Measurements have been made in the PCTR with a mixed lattice of Pu–Al fuel and thoria targets in alternating cells. Author (NSA)

N67-33923*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
NRX/EST TRANSFER FUNCTION MEASUREMENTS BY CONTROL DRUM PERTURBATION AND COMPARISON WITH COMMON ANALYSIS MODEL PREDICTIONS
G. H. Steiner Nov. 1966 136 p refs
(Contract SNP-1)
(NASA-CR-87373; WANL-TME-1476) CFSTI: HC $3.00/MF $0.65 CSCL 18L

Transfer function measurement tests were performed on the NRX/EST nuclear rocket test system. The purpose of these tests was to obtain quantitative information on the dynamic

characteristics of the basic system without controllers, to assess the advantages and disadvantages of three different methods of transfer function measurement, and to permit comparison of the response of the common analysis model used for system design and prediction with experimental results. Cross-correlation methods of transfer function measurements are compared with sinusoidal and step response results. Transfer functions were also predicted by the modified CAM-IIC computer model and were compared with experiment results. NSA

N67-33929# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
TEMPERATURE DISTRIBUTION IN A NUCLEAR REACTOR SHIELDING BLOCK [TEPLOTNI POLE VICEVRSTVOVEHO STINICIHO BLOKU REAKTORU]
J. Plann 1966 39 p refs In CZECH; ENGLISH summary
(UJV-1663)

The methods of calculating the temperature distribution in the shielding block of a nuclear reactor are described. The calculation is carried out in the one-dimensional, plane, cylindrical or spherical geometry arrangements with inner cooling. Design scheme-size, material composition, cooling method and the character of heat development throughout the volume are assumed to be given. The methods are completed with the program for the computer Gier in the ALGOL language which enables the determination of temperature distribution, heat development in particular zones, heat quantity transmitted between the zones, maximum block temperature and the coordinates of this temperature. Author (NSA)

N67-33931# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.
HETEROGENEITY EFFECTS IN SNEAK DOPPLER LOOP MEASUREMENTS
W. F. Foell Jan. 1967 19 p refs Sponsored by EURATOM
(KFK-507)

The effects of the heterogeneity of the fuel pins in SNEAK are considered. The development of reaction rates for the different fissile materials uses first-flight collision probability equations expressed in terms of lethargy. A source term is arrived at by using a narrow resonance approximation and assuming that the scattering cross section is independent of lethargy. Introducing the reciprocity theorem and using the flat source approximation, expressions for fluxes in the different regions are arrived at. Transmission probabilities for a given slab in an infinite medium are expressed in terms of first-flight collision probabilities; these are then substituted into the flux equations to give the reaction rates. The mathematics are presented in some detail. Some illustrative examples are also given. NSA

N67-33932# Bettis Atomic Power Lab., Pittsburgh, Pa.
RADIOLOGICAL CONTROL: SHIPPINGPORT PWR CORE 1, CORE 2 REPLACEMENT AND THE PWR CORE 2 MODIFICATION PROGRAM
H. W. Calley, Jr. and L. H. Kemmet, ed. Mar. 1967 51 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-298) CFSTI: HC$3.00/MF$0.65

The radiological control aspects of the refueling of the PWR Shippingport Atomic Power Station with Core 2 and the modifications performed on other reactor plant systems to accommodate the characteristics of the new core are summarized. The effect that radiological control procedures had upon the overall modification program is also discussed. No attempt is made to discuss those phases of the program which were characteristic of any normal industrial construction effort. Phases of the refueling program are discussed which entail additional or unique radiological controls. The effect of radiation and contamination on specific work tasks and on working conditions in general are discussed with the intention that it will provide instructive information for future work of a similar nature. Author (NSA)

N67-33940# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
THE METHOD OF THE SOLUTION OF HEAT CONDUCTION BOUNDARY PROBLEMS OF LONGITUDINAL FINNED REACTOR FUEL ELEMENTS [METODIKA RESENI OKRAJOVYCH ULOH PRO PODELNE ZEBROVANE PALIVOVE CLANKY JADERNYCH REAKTORU]
J. Schmid 1966 113 p refs In CZECH; ENGLISH summary
(UJV-1622)

A method for the solution of bidimensional boundary problems of heat conduction in fuel elements of nuclear reactors (at simplified boundary conditions), especially those related to longitudinally finned fuel elements, was investigated. Longitudinal fins were assumed to be of annular (or circular) sector or prismatic forms. The problem was studied for any distribution of heat sources and for boundary conditions varying along the periphery with the limitation that the problem is symmetric with respect to all symmetry axes of the fins. Problems relating to laminar flow in noncircular channels may also be solved by the same method. Author (NSA)

N67-33948# California Univ., Livermore. Lawrence Radiation Lab.
APPLICATION OF ASYMPTOTIC DIFFUSION THEORY METHODS TO SMALL SYSTEMS
R. J. Doyas and B. L. Koponen 27 Mar. 1967 15 p refs Presented at the Intern. Conf. on Res. Reactor Util. and Reactor Math., Mexico City, 2–4 May 1967
(Contract W-7405-ENG-48)
(UCRL-70012; CONF-670501-7) CFSTI: HC$3.00/MF$0.65

It is shown that by using more precise solutions to the standard boundary value problems, an improvement can be made in the accuracy of diffusion theory methods for one-region fast systems. The method is not difficult to incorporate in the diffusion theory codes, and can increase their utility for work on small, fast reactors. NSA

N67-33955# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Physics.
INTEGRAL NEUTRON THERMALIZATION Annual Summary Report, Oct. 1, 1965–Sep. 30, 1966
J. R. Beyster, H. Antunez, G. Borgonovi, W. Brouwer, G. Carriveau et al 30 Nov. 1966 548 p refs
(Contract AT(04-3)-167)
(GA-7460) CFSTI: HC$3.00/MF$0.65

The code GASKET was successfully used to generate the inelastic incoherent scattering laws for a variety of common reactor moderators. Neutron thermalization in H_2O was studied extensively, although no new model was formulated. Studies of the multiple scattering corrections to double differential measurements on H_2O were made. The corrections are important and model dependent, however, it is not possible to use them to obtain consistent results in every case. Multiple scattering corrections to angular scattering measurements were made; supporting experimental studies were also performed. For D_2O, a scattering law based on a measured frequency spectrum of Haywood was generated by GASKET. It was tested and sent to ENDF. For polyethylene, only angular scattering measurements have been performed this year. It is clear from these measurements, and comparisons made by Koppel that several discrepancies remain between experiment and theory for that moderator. Author (NSA)

N67-33974# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CONCEPT OF TRANSFER FUNCTIONS FOR A NUCLEAR REACTOR [NOTION DE FONCTION DE TRANSFERT POUR UN REACTEUR NUCLEAIRE]
Abdi Dalfes Dec. 1966 27 p refs In FRENCH
(CEA-R-3102)

The solution to the correlation equations are expressed in terms of the eigenvalues and eigenmatrices of the transport operator, for a subcritical zero power reactor. This allows to define, for each point of the reactor and for detectors detecting neutrons of given velocities, correlation and transfer functions driven by the same white-noise source. A precise meaning is also given to the importance operator, which is the adjoint of the transport operator. Author (NSA)

N67-33994# Brookhaven National Lab., Upton, N. Y.
EXPERIMENTAL STUDIES ON HIGH-GRAVITY ROTATING FLUIDIZED BEDS
G. C. Lindauer, P. Tichler, and L. P. Hatch Sep. 1966 38 p refs
(Contract AT(30-2)-GEN-16)
(BNL-50013) CFSTI: HC $3.00/MF $0.65

The behavior of a gas fluidized bed operated under high g's was investigated. The high g's were produced in a rotating vessel which contained the bed in the form of a cylindrical annulus. The bed was bounded on the outside by a porous metal ring which served as a support for the bed and distributor for the fluidizing gas. The bed particles were glass beads and the fluidizing gas was compressed air at room temperature. Accelerations up to 3450 g's and mass velocities up to 22.7 lb/sec-ft^2 were examined. It was concluded that: it was possible to operate a stable gas fluidized bed at high g's with no bubbling; complete particle mixing in the bed may occur at flow rates substantially below that required for complete fluidization; minimum fluidization data obtained at up to 2210 g's agree well with previous correlations at one g and data obtained at conditions up to 147 g's; substantial bed expansion could be obtained without particle elutriation when the rotating fluidized bed was operated at velocities greater than seven times the flow rate for minimum fluidization of the entire bed; and void fractions for beds settled under high g's were found to vary substantially with the number of g's imposed. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Metsorology; and 29 Space Radiation.

N67-32713# Lincoln Lab., Mass. Inst. of Tech., Lexington.
WAVE OPTICAL ASPECTS OF LORENTZ MICROSCOPY
M. S. Cohen 10 May 1967 72 p refs
(Contract AF 19(628)-5167)
(TN-1967-21; ESD-TR-67-264; AD-652497) CFSTI: HC $3.00/MF $0.65

The customary defocussed and Foucault modes of Lorentz microscopy are usually described in terms of geometric optics. Wohlleben has shown that geometric optics has a restricted range of validity, however; a more fundamental approach is provided by wave optics. The defocussed and Foucault modes may be discussed in terms of wave optics, and for the defocussed mode it can be shown explicitly that the geometric theory is simply the first approximation to the wave optics theory. Consideration of wave optics also leads to the proposal of two additional modes of Lorentz microscopy: Zernike phase contrast and interference microscopy; these modes cannot be described on the basis of geometric optics. The most fundamental problems in magnetic films which are amenable to study by Lorentz microscopy are investigations of the fine structures of domain walls and magnetization ripple. These problems are discussed in terms of wave optics for all four modes of Lorentz microscopy; in particular, the intensity distribution of the zero-width divergent domain wall is explicitly calculated for each mode. For practical experiments the importance of coherence, i.e., of the illumination source size, is emphasized, and the experimental aid of holography is suggested. Since the Wohlleben limit is valid for all four modes, however, there is no resolution advantage inherent in any one mode. The choice of modes for solution of the domain wall and ripple problems therefore depends upon experimental convenience. Author (TAB)

N67-32722# Mitre Corp., Bedford, Mass.
ELEMENTARY PROBLEMS IN HAMILTONIAN OPTICS
Paul J. Nawrocki Apr. 1967 73 p refs
(Contract AF 19(628)-5165)
(TM-04321; ESD-TR-65-401; AD-652652) CFSTI: HC $3.00/MF $0.65

Synges formulation for Hamiltons theory of geometric optics is used to specify the rays for a variety of problems. Based upon the analogy between ray and particle trajectories, an attempt is made to treat the problem of beyond-the-horizon atmospheric propagation. It is shown that the observed propagation law (e to the (-ks) power) can be motivated from the concept that the received signal is the sum of the Hamilton rays linking the transmitter and receiver. This implies three differences with respect to the Booker-Gordon theory for the everpresent scatter signal: a change in the correlation function from exponential to Gaussian; adoption of millimeters as the size of the characteristic fluctuations; and an extension of the critical volume to include manyfold scatter in the tropospheric path from the optical horizon to the receiver. Author (TAB)

N67-32749# Stanford Univ., Calif. Electronics Labs.
QUARTERLY STATUS REPORT NO. 105, 1 JANUARY THROUGH 31 MARCH 1967
31 Mar. 1967 103 p refs
(Contract Nonr-225(83))
(SEL-67-020; AD-653095) CFSTI: HC $3.00/MF $0.65

Progress during the period is reported under the following fields: (1) Plasma physics and quantum electronics; (2) Radioscience; (3) Solid-state electronics; (4) Systems techniques; (5) Systems theory. TAB

N67-32850# John Carroll Univ., Cleveland, Ohio. Dept. of Physics.
THE VELOCITY AND ABSORPTION OF SOUND IN VARIOUS LIQUIDS
R. A. Turk and J. L. Hunter [1966] 75 p refs
(Contract Nonr-2577(01))
(TR-8; AD-651978) CFSTI: HC $3.00/MF $0.65

The presentation is an endeavor to combine into one convenient reference the results of investigations in the area of sound velocity and absorption in liquids. The period of publications surveyed extends from 1951 to the end of 1965. TAB

N67-32894# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A NUMERICAL METHOD FOR SOLVING THE EQUATION OF TRANSFER

E. L. Gray May 1967 74 p refs
(R67SD22; AD-652089) CFSTI: HC $3.00/MF $0.65

A method is presented for numerically computing solutions to the equation of radiative transfer for plane parallel atmospheres. As part of the computational scheme, the intensity distribution is computed within the atmosphere, thus providing vertical, directionally dependent, intensity profiles as well as the intensity of radiation emerging from either boundary of the atmosphere. Since the present effort is one mainly of testing the feasibility of the scheme, the case of conservative molecular scattering was chosen, so that the results could be compared with existing tabulations. Agreement is good for optically thin atmospheres, the error increasing as the optical thickness increases. This is attributable to the fact that: (1) Polarization effects are neglected in the present scheme. (2) Accuracy is diminished due to larger altitude increments for the larger optical thicknesses. The comparisons of the computations with the exact solutions are given, as well as some results of in-atmosphere intensity calculations. Convergence seems assured for total normal optical thicknesses < or = .50. Judgment for thicker atmospheres must await an expanded program which allows for more vertical subdivisions. In conclusion, the method seems feasible, and the hope is that modifications of the method may be used for more general laws of scattering, inclusion of absorption effects, and so forth. TAB

N67-32925# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
STEM PERTURBATIONS OF THE RESONANT FREQUENCY IN A 200-MeV LINAC
K. Jellett and G. Parzen 27 Mar. 1967 5 p
(Contract AT(30-2)-GEN-16)
(BNL-11267; AADD-134) CFSTI: HC $3.00/MF $0.65

The shift in the resonant frequency of a linac cell due to the stems that support the drift tubes is computed. The frequency shift was computed using the perturbation theory result $(\Delta F/f) = -1/2[1/Z_0^2)\int E^2 dV - \int H_2 dV]/\int H^2 dV$, where the integrals in the numerator are done over the volume of the stems, and the integral in the denominator is done over the entire volume of the cell. E and H are the electromagnetic fields in the absence of the stems. NSA

N67-32932# Sandia Corp., Livermore, Calif.
ONE-POINT SAMPLER
H. W. Olson Jan. 1967 2 p refs
(Contract AT(29-1)-789)
(SCL-TN-66-113) CFSTI: HC $3.00/MF $0.65

A simple one-point sampler was devised to determine the amplitude of a fast transient pulse during an increment of time very brief compared to the total duration of the pulse. The unit constructed of off-the-shelf parts achieved accuracies of plus or minus two nanoseconds when measuring pulses with fifty nanosecond rise times. NSA

N67-33084 European Atomic Energy Community, Ispra (Italy). Materials Dept.
NON-DESTRUCTIVE CONTROL OF NON-FERROMAGNETIC METAL SHEETS BY MEANS OF EDDY CURRENTS [CONTROLE NON DESTRUCTIF DES TOLES METALLIQUES NON FERRO-MAGNETIQUES A L'AIDE DES COURANTS DE FOUCAULT]
A. Philippe Brussels, EURATOM, June 1967 50 p refs In FRENCH; ENGLISH summary
(EUR-3483.f, Vol. I)

The well-known impedance graphs of the literature are not ideal for the selection of parameters in order to adopt the best sensitivity conditions for detecting thickness and conductivity variation of a metal sheet, principally when the variations are concerning the impedance's phase. The best conditions are characterized by: (1) maximum sensitivity for the concerned parameter's variations; and (2) good signal-noise ratio. From the mathematical expression of the coil impedance, calculated in the present report, a computer gives sufficient information for graphs which make conspicuous the desired conditions. The numerical treatments by computer will be exposed in a following report. Author

N67-33206# California Univ., Livermore. Lawrence Radiation Lab.
PHYSICS DEPARTMENT REPORT, JUNE–SEPTEMBER 1966
Sep. 1966 68 p refs
(Contract W-7405-ENG-48)
(UCRL-50001-66-2) CFSTI: HC $3.00/MF $0.65

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4. RADIATION AND PLASMA PHYSICS K. Nishimura p 51–55 refs (See N67-33210 19-25)
5. MATHEMATICAL AND COMPUTATIONAL METHODS R. DeBar p 56 (See N67-33211 19-23)

N67-33211# California Univ., Livermore. Lawrence Radiation Lab.
MATHEMATICAL AND COMPUTATIONAL METHODS
R. DeBar *in its* Phys. Dept. Rept., Jun.–Sep. 1966 Sep. 1966 p 56 (See N67-33206 19-23)

Mathematical and computational work continued on debugging the KRAKEN multifluid Eulerian hydrodynamics code. This code differs from the CEL code in that more than one type of material is permitted in the Eulerian regions. A detailed investigation of some of the problems of numerical solution of the transport equation was undertaken. The problem of truncation was solved and it was proved that in all orders this general form involves at most two adjustable scalar parameters. R.U.

N67-33217# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
STUDIES OF ELEMENTS USED IN HERTZIAN INTERFEROMETRY (MILLIMETRIC WAVES). MEASUREMENT OF THE PERMITTIVITY OF A LIQUID DIELECTRIC [ETUDES D'ELEMENTS UTILISES EN INTERFEROMETRIE HERTZIENNE (ONDES MILLIMETRIQUES). MESURE DE LA PERMITTIVITE DE DIELECTRIQUE LIQUIDE]
Michel Degal (Ph.D. Thesis—Paris Univ.) 1966 99 p refs In FRENCH; ENGLISH summary
(CEA-R-2993)

This study is about the design of the following elements: horns, horns associated with lens, and power separators used in EHF interferometry. Assemblies allowing measurements of complex dielectric constants of liquids were studied. These devices are used in free propagation about wave lengths ≤ 2mm. Liquids used were: octane from 50 to 70°C (58 to 158°F), monochlorobenzene at 22.8°C (73°F), mixture of octane with 10.8% citral at 22°C (72°F), and benzene at 21°C (70°F). Author

N67-33422*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ULTRAVIOLET CALIBRATION PROCEDURES FOR GEMINI EXPERIMENT M-407

Roy C. Stokes and John E. Novotny Jul. 1967 35 p refs
(NASA-TM-X-58009) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Ultraviolet radiometric calibration and data analysis techniques were developed for Gemini inflight experiment M-407. The object of the experiment was to measure the spectral albedo of the moon between 2000 and 3200 Å using an objective grating spectrograph. Because of unfavorable phase angles of the moon during Gemini flights X, XI, and XII, the experiment could not be conducted. However, considerable effort was devoted to the project in the areas of technique development related to performance and evaluation of the in-flight measurements. A brief summary of the experiment with a description of the hardware, the ultraviolet calibration techniques, and the data reduction techniques developed for the experiment are given. Author

N67-33460*# Wyle Labs., Inc., Huntsville, Ala.
ON THE PREDICTION OF THE NEAR FIELD NOISE OF SUPERSONIC JETS
J. B. Ollerhead Washington, NASA, Aug. 1967 110 p refs
(Contract NAS8-21060)
(NASA-CR-857; WR-67-8) CFSTI: HC $3.00/MF $0.65 CSCL 20A

The phenomenon of noise generation by supersonic jets is reviewed in a comparison of previous theoretical and experimental investigations. It is shown that three fundamental mechanisms exist, which are defined as turbulence-shear noise, Mach wave radiation, and shock-noise. The significance of each type of noise is evaluated, with reference to the nature of the jet-flow structure and particular attention is paid to the acoustic near field. At the present time there is no general method for the prediction of the near field noise of either subsonic or supersonic jets. An appropriate expression is presented, and a series of experiments proposed, by which its empirical coefficients can be determined. These experiments would eventually lead to the establishment of scaling laws, enabling the expression to be used to compute the near field sound pressure contours of any supersonic jet of known configuration. Author

N67-33512# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
MULTIPLE SCATTERING OF ACOUSTICAL WAVES
David J. McCloskey May 1967 27 p refs
(Contract N00014-67-0094-0009)
(Rept.-85-40; AD-653868) CFSTI: HC $3.00/MF $0.65

The general theory of the multiple scattering of acoustical waves by a random distribution of isotropic point scatterers is considered. Configurational averages are taken of the equations of multiple scattering and integral equations governing these configurational averages are obtained; the physical consequences of these equations are examined in detail. A complete theoretical picture is obtained of the propagation of the coherent and incoherent radiation and the connection between the coherent and incoherent contributions to the average sound intensity and current. Author (TAB)

N67-33858# Atomics International, Canoga Park, Calif.
CHARACTERIZATION OF AEROSOLS PRODUCED BY SODIUM FIRES. VOLUME I: SOLUTIONS OF A GENERAL EQUATION FOR THE COAGULATION OF HETEROGENEOUS AEROSOLS
M. A. Greenfield (Calif. Univ., Los Angeles), P. Spiegler, J. G. Morgan, and R. L. Koontz 1 May 1967 35 p refs
(Contract AT(04-3)-701)
(NAA-SR-11997, Vol. I) CFSTI: HC $3.00/MF $0.65

An IBM 7094 digital computer was used in solving the equation that describes in time the behavior of an aerosol. The topics investigated include coagulation of a heterogeneous aerosol, coagulation coupled with stirred settling, and an external source that continuously generates new particles. In some instances, approximations to the code results may be obtained, provided simplifying assumptions are made. The results indicate that the aerosol concentration is a more important parameter than the initial particle spectrum. Author (NSA)

N67-33865 Warsaw Univ. (Poland). Dept. of Radiochemistry.
SOME NEW SOLUTIONS OF THE GRAVITATIONAL FIELD EQUATIONS
Bronislaw Kuchowicz Nov. 1966 20 p refs

Till now only few explicit solutions of Einstein's gravitational equations for radially symmetric distributions of matter are known. Usually, for a given e-λ, one obtains a second order differential equation from with eν should be determined; the latter equation is not always integrable in terms of known functions. It is proposed that the function e-λ satisfies some first order differential equation related in a certain way to the differential equation for eν. Some types of the proposed equations are examined and several new explicit solutions of Einstein's field equations in space filled with matter are found. The procedure outlined also allows further solutions to be found. Author

N67-33954# Brandeis Univ., Waltham, Mass. Dept. of Physics.
SOME REMARKS ABOUT SPINWAVES AND ZERO SOUND IN LOW TEMPERATURE LIQUID He3
Gottfried T. Schappert May 1967 12 p refs
(Contract AF 19(628)-5833)
(SR-629; AFCRL-67-0323; AD-654015) CFSTI: HC $3.00/MF $0.65

The dispersion relations for zero sound and spin waves in low temperature Landau Fermi liquids are analyzed. It is pointed out that besides the well-known condition for the propagation of m = 1 modes F sub 1 > 6 or G sub 1 > 6, the m = 0 modes require F sub 1 > -F sub 0/(1 + 1/3 F sub 0) or G sub 0 > -G sub 0/(1 + 1/3 G sub 0). Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-32754# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A THEOREM ON SPIN-EIGENFUNCTIONS
Thomas A. Kaplan and Walter H. Kleiner 24 May 1967 18 p ref
(Contract AF 19(628)-5167)
(ESD-TR-67-277; TN-1967-15; AD-652840) CFSTI: HC $3.00/MF $0.65

A theorem is proved to the effect that a wave function for a set of N spins, which is a product of single-spin wave functions and which is an eigenstate of the square of the total spin, must be a state with the maximum possible value of SZ, Z being an arbitrary direction. This theorem has been applied in a separate work to show strikingly that the imposition of symmetry restrictions of a common type on an approximate wave function can lead to a very poor physical description. TAB

N67-32784# Joint Inst. for Nuclear Research, Dubna (USSR).
DISPERSION SUM RULES FOR DEUTERON DISINTEGRATION PROCESSES IN POLE APPROXIMATION
K. Lewin and D. Robaschik 1967 7 p refs In RUSSIAN
(JINR-E02-3205)

The dispersion sum rule for the photodisintegration process gives $\mu_p=0$ and vanishing d-state probability for the deuteron ground state in the lowest approximation. Author (NSA)

N67-32768# Roanoke Coll., Salem, Va. Dept. of Physics.
PROTON SPUTTERING Annual Report, 1 Jun. 1966–28 Feb. 1967
Charles R. Finfgeld 28 Feb. 1967 15 p
(Contract AF(40-1)-3557)
(ORO-3557-1; AR-1) CFSTI: HC $3.00/MF $0.65

The design of a system to be used for measurement of the yield and angular distribution of Au sputtered by protons of energies between 1.0 and 11.0 keV is discussed briefly, and progress in preparation of the components of the system is reported. The system is about to be assembled. NSA

N67-32777# Stanford Univ., Calif. High Energy Physics Lab.
ELECTRON-INDUCED CASCADE SHOWERS IN COPPER, TIN, AND LEAD
Carol Jo Crannell Mar. 1967 51 p ref Submitted for publication
(Contract Nonr-225(67); Grant NSF GP-948)
(HEPL-495; AD-652345)

Electromagnetic cascade showers induced by 900-MeV electrons were studied in copper, tin, and lead targets. A small, parallel incident beam with negligible background contamination was employed to achieve good resolution and undistorted development of the shower. The three-dimensional spatial distribution of energy deposition was measured with a CsI(Tl) detector placed at various positions in a small hole in an otherwise solid block of material. Measurements were extended to radii of 7 Moliere lengths and depths of 30 or more radiation lengths. Additional data for showers induced by 200-MeV electrons incident on lead are also presented. The results of this experiment are compared with the results of previous experiments and with the predictions of recent Monte Carlo calculations. The measured longitudinal distribution of energy is in good agreement with theoretical predictions, while the radial distributions show an unpredicted dependence on the atomic number of the target material. Author (TAB)

N67-32779# Harvard Univ., Cambridge, Mass.
CYCLOTRON LABORATORY, HARVARD UNIVERSITY Quarterly Progress Report, 1 Dec. 1966–28 Feb. 1967
Harold Glaser 1 Mar. 1967 11 p
(Contract Nonr-1866(56))
(AD-652016) CFSTI: HC $3.00/MF $0.65

The following activities and studies are briefly summarized: cyclotron operation; (p, p α) knockout reactions; n-p incoherent scattering cross section; (n,p) and (n,d) reactions; use of proton beams in radiation theory, irradiation of murine tumors, and the production of cataracts; space radiation problems; resonant absorption in SN119 at low temperature; nuclear magnetism in solid H2; masses of XE isotopes; induced changes in radioactive decay constants, resonant gamma-ray scattering from HF176; nuclear interaction in molecules; atomic hydrogen maser. TAB

N67-32784# University of Southern Calif., Los Angeles. Dept. of Physics.
ELASTIC SCATTERING SEARCH PROGRAM
William R. Smith Feb. 1967 63 p refs
(Contract AT(04-3)-136)
(USC-136-119) CFSTI: HC $3.00/MF $0.65

A FORTRAN computer program is described which employs the optical model to calculate the elastic scattering resulting from the collision of any two nuclear particles. The spin–orbit coupling potential acting between the two particles can also be included provided that the incident particle has spin zero, one-half, or one. The optical model potential is composed of a three-parameter Woods–Saxon real part and an independent four-parameter imaginary part having a variable ratio of surface and volume components. The program also includes a search routine which automatically seeks the parameters which yield the best least-squares agreement between the calculated predictions and the experimental data. Author (NSA)

N67-32785# California Univ., Livermore. Lawrence Radiation Lab.
GROWING ROLE OF COMPUTERS IN THE NUCLEAR ENERGY FIELD
S. Fernbach 3 May 1967 25 p refs Presented at the Intern. Conf. on Res. Reactor Util. and Reactor Math., Mexico City, 2–4 May 1967
(Contract W-7405-ENG-48)
(UCRL-70422; CONF-670501-8) CFSTI: HC $3.00/MF $0.65

The use of computers in the nuclear energy field is reviewed from 1950 to the present. The use of computers in nuclear research is doubling each year. Computers are particularly suitable for studies of nuclear weapons, nuclear reactors, controlled thermonuclear reactors, and research on industrial uses of nuclear devices. Small computers for control and data acquisition in nuclear science laboratories are practical. Simulation and design of equipment, experiments and mathematical problems can be accomplished on-line. Computer growth is predicted to continue at its present rate for the next five years. NSA

N67-32802# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
A NEW NEUTRON-DEFICIENT ISOMER OF CESIUM [NOVYI NEITRONODEFITSITNYI IZOMER TSEZIYA]
K. Aleksander, V. Noibert, and Kh. Potter 1967 14 p refs In RUSSIAN
(JINR-P7-3185)

A previously unreported isomeric state with a gamma transition energy of 98±10 keV and a half life of 0.5±0.05 sec was found. The isomer was excited in the reactions $^{112}Cd(^{14}N,xn)$ and $^{113}In(^{12}C,xn)$. The mass number, following from excitation function measurements, is probably 122. The multipolarity, determined via conversion electron measurements, is M2. Author (NSA)

N67-32847# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
NEW INTERPRETATION OF THE QUASIELASTIC SCATTERING OF SLOW NEUTRONS IN WATER
I. Pelah and Y. Imry Nov. 1966 16 p refs
(IA-1063)

The quasielastic scattering of slow neutrons in water is described according to the following model. At room temperature, water consists of aggregates of a few hundred H_2O molecules each. The aggregates are weakly interacting and form a structure with a characteristic temperature of about 3°K. The scattered neutron spectrum from this system at low energy transfers consists of a superposition of multiphonon processes. This gives an effect roughly similar to a broadening of the elastic line, although a fine structure caused by individual n-phonon processes exists, as observed by high resolution experiments. Experiments with low resolutions or higher momentum transfer (≥ 4 Å^{-1}) will not detect the details of the spectrum and only a heavy-gas picture will be revealed. The internal motions of molecules in the aggregates determine the inelastic part of the neutron spectrum. With increasing temperature the aggregate size drops and the broadening increases. The possible advantages of this picture over the existing diffusion models are indicated. Author

N67-32853# Illinois Univ., Urbana. Dept. of Physics.
NORMALIZATION OF BETHE-SALPETER AMPLITUDES
K. Nishijima and A. H. Singh [1966] 21 p refs
(Contract N00014-67-A-0305-0005; Grant NSF GP-6188)
(AD-651984) CFSTI: HC $3.00/MF $0.65

Many different methods for normalizing Bethe-Salpeter amplitudes for bound states have been known. In this article derivations of the normalization condition based on conservation of charge and of energy-momentum are studied in detail, and it is shown that the final result in both cases is identical with the one derived from other methods. Author (TAB)

N67-32868# Illinois Univ., Urbana. Dept. of Physics.
PHOTON SCATTERING BY THE GIANT MAGNETIC DIPOLE STATES IN ^{12}C, ^{24}Mg, AND ^{28}Si
H. W. Kuehne, P. Axel, and D. C. Sutton [1967] 49 p refs
(Contract Nonr-1834(05))
(AD-651992)

Photons, defined in energy to about 1% with the aid of a bremsstrahlung monochromator, were scattered by isolated energy levels in C, Mg, and Si. Parameters for the six observed levels are given. The 15.11 MeV level in C12, the 9.92 and 10.66 MeV levels in Mg24, and the 11.42 MeV level in Si28 are T = 1, T sub z = 0 analogues of low lying 1+ states in the neighboring odd-odd nuclei. These levels exhaust most of the magnetic dipole transition strength of the respective nuclei, and therefore give information about the expectation value of l.s in the ground state. TAB

N67-32900# Lehigh Univ., Bethlehem, Pa. Dept. of Physics.
CHARACTERISTICS OF THE THALLOUS DIMER CENTER IN SODIUM IODIDE
George Kenneth Herb (Ph.D. Thesis) Oct. 1966 278 p refs
Sponsored in part by Armstrong Cork Co.
(Contract AT(30-1)-3408)
(TID-23773) CFSTI: HC $3.00/MF $0.65

Characteristics of the thallous double center (dimer) in sodium iodide were studied over the temperature range 15° to 300°K, and for thallium concentrations of 0.06 to 1.01 mole % Tl. A measurement of the lifetime of the dimer excited state resulted in a value of 7 nanoseconds as the upper limit. The method described to measure the decay time is applicable to other phosphors. The dimer decay time was found to be independent of temperature and thallium concentration for the ranges investigated. A measurement of the dimer orientation with polarized light gave a nondefinitive result. In addition to the earlier proposed (110) orientation, the present study strongly suggests a (100) orientation. The model of the dimer absorption–emission process is shown to be one in which the absorption and emission processes are orthogonal. Author (NSA)

N67-32911# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
EFFECT OF EXCHANGE AND THE PAULI PRINCIPLE ON NUCLEUS SCATTERING, PART I
William A. Friedman and Herman Feshbach Mar. 1967 23 p refs
(Contract AT(30-1)-2098)
(MIT-2098-302) CFSTI: HC $3.00/MF $0.65

A method for the explicit treatment of identical-particle effects in the case of the N-coupled-channel problem is discussed, together with the problems that are raised by anti-symmetrization and exchange scattering. The formulation of the N-coupled-channel problem to eliminate these difficulties is also discussed. TAB

N67-32913# Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina).
DETERMINATION OF CONVERSION COEFFICIENTS IN THE DECAY OF Ba-133 BY MEANS OF SEMICONDUCTOR COUNTERS
H. E. Bosch, E. Szichman, A. Baseggio, and R. Dolinkue Dec. 1966 17 p refs
(Grant DA-ARO-48-092-66-G121)
(NP-16671)

The K-conversion coefficients corresponding to four transitions in ^{133}Cs were determined using the electron–gamma coincidence method. The gamma rays were detected with conventional scintillation counters. A special electron–gamma coincidence spectrometer was constructed by using, as the electron detector, a lithium-drifted semiconductor counter operated in a vacuum chamber at low temperature. An analysis of electron–conversion spectra was performed by studying the line shapes of standard single lines as a function of the energy. The following values were obtained: $\alpha_K(0.081) = 1.34 \pm 0.09$, (K/LM = 5.4 ± 0.5); $\alpha_K(0.277) = 0.054 \pm 0.010$, (K/LM = 5.5 ± 1.5); $\alpha_K(0.305 = 0.037 \pm 0.003$; and $\alpha_K(0.356) = 0.023 \pm 0.002$, (K/LM = 5.0 ± 0.5). As a by-product the conversion coefficient for the 0.376 MeV transition was determined by analysis of the singles electron and gamma spectra, its value being $\alpha_K(0.386) = 0.028 \pm 0.010$, (K/LM = 5 ± 1). Author (NSA)

N67-32927# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
IONIZATION OF A CESIUM ATOM BY AN ABSORPTION PROCESS INVOLVING TWO PHOTONS FROM A LASER BEAM [IONISATION D'UN ATOME DE CESIUM PAR UN PROCESSUS D'ABOSRPTION A DEUX PHOTONS ISSUS D'UN FAISCEAU LASER]
Yves Gontier and Michel Trahin Jan. 1967 35 p refs In FRENCH
(CEA-R-3113)

The expression giving the ionization cross section of an atom, by an absorption process involving two photons produced from a laser beam, is derived. The nonrelativietic case is considered and the dipolar approximation used. The summation over the intermediate states is carried out rigorously by means of a special technique which is described in detail. A method is presented which makes it possible to obtain the numerical solution. Author (NSA)

N67-32929# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ISOTOPIC INVARIANCE VIOLATION AND PION FROM FACTOR
A. V. Efremov 1967 19 p refs In RUSSIAN
(JINR-E02-3224)

On the basis of minimal electromagnetic interaction hypothesis and some approximation the nonlinear integral equation for pion form factor is obtained. An approximate analytical solution of this equation is given, the form factor appears to be dependent only on the fine structure constant, the mass of the pion and their mass difference. The r.m.s. radius is found to be 0.3 f. Author (NSA)

N67-32931# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DIVERGENCES OF VECTOR AND AXIAL-VECTOR CURRENTS IN STRONG INTERACTION
I. Montvey 1967 11 p In RUSSIAN
(JINR-E02-3196)

Models for the SU(3) × SU(3) breaking part of strong interactions are considered. The divergence of vector and

axial-vector currents is given explicitly. It is argued that the hypothesis of Pole Dominated Divergence of Axial-vector Current (PDDAC) can be maintained as an approximately valid dynamical consequence of the strong interactions, independently of the form of the divergence condition for the axial-vector current. As an application the meson photoproduction near threshold is considered taking into account the SU(3) breaking. Author (NSA)

N67-32940# Defense Research Corp., Santa Barbara, Calif.
CALCULATION OF SCATTERING AND REACTION CROSS SECTIONS Technical Memorandum, 1 Jan.–31 Dec. 1966
B. A. Lippmann, Thomas F. O'Malley, and Peter J. Redmond Jan. 1967 91 p refs
(Contract DA-49-083-OSA-3132; ARPA Order 367; Proj. Defender)
(TM-560; AD-649507) CFSTI: HC $3.00/MF $0.65

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8. TREATMENT OF ANGULAR MOMENTUM IN MOMENTUM SPACE P. J. Redmond p 65–77 (See N67-32948 19-24)

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N67-32941# Defense Research Corp., Santa Barbara, Calif.
OPERATOR FOR TIME DELAY INDUCED BY SCATTERING
B. A. Lippmann *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 7–10 refs Submitted for publication (See N67-32940 19-24)

The operator that gives the time delay induced by a scattering process is exhibited explicitly. Author

N67-32942# Defense Research Corp., Santa Barbara, Calif.
A NOTE ON SCATTERING VARIATIONAL PRINCIPLES
B. A. Lippmann *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 11–14 (See N67-32940 19-24)

The Schwinger variational principle is converted into a slightly modified form of the Kohn–Hulthen variational principle. A generalization of the new form, valid for rearrangement collisions, is given. Author

N67-32943# Defense Research Corp., Santa Barbara, Calif.
INTEGRAL EQUATIONS FOR MULTI-CHANNEL COLLISIONS
B. A. Lippmann *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 15–20 refs (See N67-32940 19-24)

Two new integral equations to describe multichannel collisions are given: one uses an explicit cut-off radius; the other does not. The new integral equations possess symmetrical kernels, thereby facilitating the application of the Pauli principle and permitting the asymptotic scattered amplitude in each channel to be derived simply. The limit $\epsilon \to 0$ does not result in a homogeneous integral equation. Author

N67-32944# Defense Research Corp., Santa Barbara, Calif.
CALCULATION OF DISSOCIATIVE ATTACHMENT IN HOT O_2
Thomas F. O'Malley *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 21–37 refs Submitted for publication (See N67-32940 19-24)

The very striking temperature dependence of the dissociative attachment cross sections found experimentally in O_2 has been reproduced by a semiempirical calculation, assuming a Maxwell distribution of vibrational (v) and rotational (r) states. A recently derived expression for the cross section $\sigma_{v,r}$ is used, and the final state potential curve of O_2^- is parametrized to fit the experiments. The temperature shift is found to be caused by the effect on excited vibrational states of the rapidly varying survival probability, a measure of the competition between autoionization and dissociation. By-products of the calculation are the potential curve for the final dissociating state of O_2^- together with an estimate of its autoionization width, $\Gamma_d(R)$, and also the contribution of this state to the total cross section for electron energy loss to vibrational excitation and dissociation. Author

N67-32945# Defense Research Corp., Santa Barbara, Calif.
QUASI-ADIABATIC MOLECULAR STATES: AN ALTERNATIVE TO THE NON-CROSSING RULE
Thomas F. O'Malley *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 39–49 refs Submitted for publication (See N67-32940 19-32)

Because of the noncrossing rule, the conventional definition of adiabatic states has been increasingly regarded as unsuitable for describing collisions. An alternative definition based on a generalization of the resonance is given, defining states which may cross freely. As an immediate application, these states tend to resolve a serious discrepancy in the interpretation of recent He_2^+ recombination data. Author

N67-32946# Defense Research Corp., Santa Barbara, Calif.
THEORY OF RESONANT DISSOCIATIVE RECOMBINATION
Peter J. Redmond *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 51–55 refs Presented at the 5th Inter. Conf. on the Phys. of Electron. and Atomic Collisions (See N67-32940 19-24)

The theory is developed with particular emphasis on the interaction of the resonant state and the infinite set of Rydberg states crossed by the resonant state. It is shown that the interaction is large only for a finite subset of the Rydberg states. Author

N67-32947# Defense Research Corp., Santa Barbara, Calif.
FORMULATION OF THE TWO-STATE PROBLEM IN TERMS OF ADIABATIC POTENTIAL CURVES
Peter J. Redmond *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 57–64 refs (See N67-32940 19-24)

When two molecular adiabatic potential curves nearly cross, the electronic wave function is a rpaidly varying function of the internuclear separation. The one-state Born–Oppenheimer approximation is then not valid. By introducing appropriate linear combinations of the two adiabatic states involved a two-state Born–Oppenheimer approximation can be made. The resulting pair of coupled equations for the nuclear wave function are identical with those obtained in the conventional two-state theories. However, all the parameters can be determined by an inspection of the adiabatic curves and the validity of the approximation scheme can be justified. Author

N67-32948# Defense Research Corp., Santa Barbara, Calif.
TREATMENT OF ANGULAR MOMENTUM IN MOMENTUM SPACE
Peter J. Redmond *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 65–77 (See N67-32940 19-24)

Equations are derived, in a momentum space representation, for the wave function of a many body system with a definite angular momentum. Invariance of the Hamiltonian under time reversal, parity, and exchange has simple consequences for a three-body system. Author

N67-32949# Defense Research Corp., Santa Barbara, Calif.
ON THE SLOPE OF ENERGY CURVES AS THEY ENTER THE CONTINUUM
Peter J. Redmond *In its* Calculation of Scattering and Reaction Cross Sect. Jan. 1967 p 79–83 refs Submitted for publication (See N67-32940 19-24)

Let the Hamiltonian $H(\lambda)$ have a bound state with binding energy $E(\lambda)$ such that the $E(\lambda) \rightarrow 0$ as $\lambda \rightarrow \lambda^*$. It is shown that $dE(\lambda)/d\lambda = 0$ at $\lambda = \lambda^*$ for s-states and that $dE(\lambda)/d\lambda \neq 0$ for higher angular momentum. As an application of this theorem it is shown that there is a low lying p-wave resonance in the scattering of an electron by molecular hydrogen. Author

N67-32980# Illinois Univ., Urbana. Dept. of Physics.
RAPIDLY DECREASING FORM FACTORS AND INFINITELY COMPOSITE PARTICLES
John D. Stack 1967 29 p refs
(Contract N000014-67-A-0305-0005)
(AD-652827) CFSTI: HC $3.00/MF $0.65

The problem of understanding the asymptotic behavior of hadron electromagnetic form factors is considered. It is shown that if the hadrons form a bootstrap, each hadron must be a bound state of an infinite number of particles, or infinitely composite. A simple model containing an infinitely composite particle is constructed and the form factor of the particle is calculated. The form factor decreases exponentially for large space-like momentum transfers. On the basis of this it is suggested that a criterion for a bootstrap should be exponentially decreasing form factors for all hadrons. Author (TAB)

N67-32998# International Centre for Theoretical Physics, Trieste (Italy).
PARTIAL WAVE ANALYSIS, PART I
R. Delbourgo (Imp. Coll. of London), J. F. Boyce, Abdus Salam, and J. Strathdee Feb. 1967 94 p
(IC-67-9, Pt. I)

An attempt is made at a systematic and self-contained presentation of the group theoretic basis of harmonic analysis using the time-like, space-like, light-like, and null representations. It is shown how an expansion of the amplitude may be carried through, not only in the forward direction, but for all momentum transfers and for all values of helicity flip. This type of expansion, with its new separation of the kinematical factors, will allow a more systematic use of analyticity in the σ plane for all processes at all momentum transfers, possibly giving a further insight into what may yet be learned from a deeper analysis of the Poincare group. NSA

N67-33000# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
PARTICLE LOSS BY TOUSCHEK EFFECT IN A STORAGE RING
Uta Voelkel Mar. 1967 18 p refs
(DESY-67/5)

A formula for the loss rate of electrons from a stored beam due to the so-called Touschek effect is derived starting with the exact Moeller scattering cross section. For rectangular distribution of transverse momentum, this formula is integrated explicitly. For gaussian distribution it is expanded in a series of $1/\delta q$ (rms of transverse momentum), which is computed for $0.3 \leq \delta q \leq 10$ (in mc). The difference between both distributions in this region turns out to be less than 1%, so that the explicit formula for rectangular distribution can be used for all practical purposes. Author (NSA)

N67-33024* Queens Univ., Belfast (Northern Ireland). Dept. of Applied Mathematics.
HIGH ORDER COLLISION INTEGRALS Final Report
Francis J. Smith [1967] 11 p refs
(Contract NSR-52-112-001)
(NASA-CR-86991) CSCL 20H

High order collision integrals have been calculated for the potentials $V(r) = Ae^{-r/\rho}$ and $\pm C/r^n$ for n=2, 3, 4, 5, 6, 8, 10, 15, 25, 50. These should enable transport properties to be calculated for these potentials to a higher accuracy than previously. Some previous calculations of collision integrals for these potentials have been checked. Author

N67-33040# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
DIRECT REACTIONS INDUCED BY HEAVY IONS
V. V. Volkov 1967 14 p refs Presented at the Intern. Conf. on Nucl. Phys., Gatlinburg, Tenn., 1966
(JINR-E7-3155; CONF-660906-47)

The experimental data on the study of direct reactions with the transfer of one, two, and three neutrons, a proton, and ^{4}He are given. The excitation functions, angular distributions, and energy spectra were measured for several elements. In the reactions $^{27}Al(^{12}C, ^{13}N)^{26}Mg$ and $^{12}C(^{12}C, ^{13}N)^{11}B$, the diffractional structure was observed in the angular distributions. A sharp dependence of the cross section upon Z of the target nucleus due to polarization of the proton wave function in the Coulomb field of the target nucleus was found in the reaction $(^{12}C, ^{13}N)$. The angular distribution and energy spectrum in the reaction $(^{15}N, ^{17}N)$ with ^{90}Zr, ^{92}Zr, ^{94}Zr targets were studied with a view of finding the effect of the structure on the reaction parameters. The complicated character of the spectrum obtained in the reaction $^{27}Al(^{14}N, ^{18}F)$ indicates the existence of two mechanisms in the ^{4}He transfer reaction. In the bombardment of ^{181}Ta and ^{159}Tb with ^{20}Ne and ^{22}Ne ions, data were obtained on the transfer-reaction spectrum. Author (NSA)

N67-33062# Massachusetts Inst. of Tech., Cambridge
BRANCHING DIAGRAMS
R. Gilmore *In its* Solid-State and Mol. Theory Group 15 Apr. 1967 p 43–48 refs (See N67-33058 19-26)

Branching diagrams for SU(2) or spin 1/2 particles, SU(3) or spin 1 particles, U(2), and U(3) are presented. The methods used in obtaining the diagrams are described, along with the mechanics of obtaining the number of states of total spin. C.T.C.

N67-33063# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ISOSHID-II: CODE REVISION TO INCLUDE CALCULATION OF DOSE RATE FROM SHIELDED BREMSSTRAHLUNG SOURCES
G. L. Simmons, J. J. Regimbal, J. Greenborg, E. L. Kelly, Jr., and H. H. Van Tuyl Mar. 1967 41 p refs
(Contract AT(45-1)-1830)
(BNWL-236, Suppl. 1) CFSTI: $3.00/MF $0.65

The ISOSHLD-II shielding code is principally intended for use in calculating the radiation dose, at a field point, from

bremsstrahlung and/or decay gamma rays emitted by radioisotope sources. This program, with the newly added bremsstrahlung mode, is an extension of an earlier version (ISOSHLD). Five shield regions can be handled with up to twenty materials per shield; the source is considered to be the first shield region, i.e., bremsstrahlung and decay gamma rays are produced only in the source. Point kernel integration (over the source region) is used to calculate the radiation dose at a field point. Data needed to calculate fission-product isotopic concentrations, source spectrum distributions, and attenuation coefficients are contained in libraries used by the code. Problem input data are thereby minimized; the information required specifies the source–shield configuration and identifies the relevant materials and their densities. Author (NSA)

N67-33065# Los Alamos Scientific Lab., N. Mex.
THE ^{233}U FISSION AND CAPTURE CROSS SECTIONS AND THEIR ANALYSIS AT LOW ENERGIES
Delmar W. Bergen (Ph.D. Thesis–New Mexico Univ.) 4 May 1967 76 p refs
(Contract W-7405-ENG-36)
(LA-3676-MS) CFSTI: HC $3.00/MF $0.65

The ^{233}U fission and capture cross sections were measured using a nuclear-device neutron source and time-of-flight techniques. Cross section data are presented from 20 to 10^6 eV for fission and from 20 to 63 eV for fission + capture. The resonance region (20 eV to 63 eV) was fitted with both a single-level function consisting of a sum of Breit–Wigner levels and the Reich and Moore multilevel function based on R-matrix theory. The resulting resonance parameters are listed and discussed. In order to establish the validity of the resonance parameters derived from the multilevel fit, a study is presented of the cross section derived from two and three hypothetical resonances under various conditions and of the cross sections obtained from randomly generated resonances. Author (NSA)

N67-33081# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
CALCULATION OF THE FRACTIONAL RELEASE OF GASES FROM A SPHERE AFTER RECOIL BOMBARDMENTS
H. J. Matzke (Braunschweig Tech. Univ.) and G. Di Cola Brussels, EURATOM, Jun. 1967 15 p refs
(EUR-3488.e) CFSTI: HC $3.00/MF $0.65

The gas release from a recoil-bombarded sphere of inert material on annealing at a given temperature is calculated. Two sources of recoil gas atoms are considered: one of infinite width, the other infinitesimally thin compared to the recoil range in the source. Some additional results are presented for the release from a recoil-bombarded cylinder. Derived equations are given and values of the fractional release, F, are tabulated and reproduced in figures using results obtained from a standard 7090 IBM electronic computer. Author

N67-33096# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH-ENERGY-PHYSICS EXPERIMENTS WITH POLARIZED TARGETS
Owen Chamberlain Dec. 1966 56 p refs Presented at the Conf. on Polarized Targets and Ion Sources, Saclay, France, Dec. 1966
(Contract W-7405-ENG-48)
(UCRL-17433; CONF-661205-3) CFSTI: HC $3.00/MF $0.65

Experiments with polarized proton targets are reviewed in detail. These experiments include both proton–proton and meson (π)–proton interactions. Such experiments are undertaken in order to obtain knowledge of the spin dependence of the forces in strong interactions. NSA

N67-33162# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
STUDY OF THE DISPERSION PHENOMENA CONNECTED WITH THE ABSORPTION BY RECOILLESS NUCLEAR RESONANCE FLUORESCENCE [ETUDE DES PHENOMENES DE DISPERSION LIES A L'ABSORPTION RESONNANTE SANS RECUL DES NOYAUX ATOMIQUES]
Pierre Imbert (Ph.D. Thesis—Paris Univ.) 1966 72 p refs In FRENCH; ENGLISH summary
(CEA-R-2925) CFSTI: HC $3.00/MF $0.65

In nuclear resonance fluorescence as in the optical field anormal dispersion curves are related to the absorption lines. It is possible, by using quadrupolar or magnetic splitting of the line in the case of recoilless resonance fluorescence (Mössbauer effect) to obtain differential dispersion effects between the two orthogonal linear or the two inverse circular components of the incident gamma radiation. These effects induce birefraction phenomena or Farraday rotation on the gamma beam, which have been studied on Fe-57 enriched absorbers. Author

N67-33176# Royal Society of New Zealand, Wellington.
ABSTRACTS OF PAPERS TO BE READ AT THE INTERNATIONAL CONFERENCE ON HYPERFINE NUCLEAR SPECTROSCOPY
Oct. 1966 42 p refs Conf. held at Wellington, New Zealand, 17–21 Oct. 1966
(CONF-661046) Available from Roy. Soc. of New Zealand, Wellington: 5s

Topics covered include: Mössbauer spectroscopy, atomic and nuclear model calculations of spectroscopic properties, electron–nuclear interactions in compounds, isomer shifts, quadrupole splittings, nuclear magnetic resonance techniques, nuclear hyperfine couplings, crystal spectroscopy and intermolecular forces, electron spin resonance, nuclear orientation, magnetic hyperfine spectra, solid-state effects of nuclear transformations, and uses of Mössbauer effect in various studies. NSA

N67-33177# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ALGEBRA OF CURRENT DENSITIES AND FORM FACTORS [ALGEBRA PLOTNOSTEI I FORM-FAKTORY]
A. V. Efremov and V. V. Stepanov 1967 6 p refs In RUSSIAN Submitted for publication
(JINR-P2-3244)

It is shown that the covariant formulation of the current density algebra, in the case when it is limited in the intermediate state by the same multiplet as the initial and final one, leads to the system of equations for form factors. This system has only a trivial solution, i.e., normal form factors are equal identically to 1, while anomalous ones are equal to 0. Author (NSA)

N67-33207# California Univ., Livermore. Lawrence Radiation Lab.
NUCLEAR AND ATOMIC STRUCTURE
J. T. Sparks and T. Komoto *In its* Phys. Dept. Rept., Jun.–Sep. 1966 Sep. 1966 p 1–39 refs (See N67-33208 19-23)

Both theoretical and experimental progress is reported on nuclear and atomic structures of the University of California Physics Department report. Theory is expounded on such topics as: nucleon–nucleon elastic scattering matrix, electron scattering on polyatomic molecules, evaluated photon cross-section library, a double hypernucleus, eigenvalue of a four-body problem, and extrapolation of pion–pion scattering amplitudes. Experimental work is outlined on several fission cross-sections, alpha-neutron cross-sections on O^{17} and O^{18}, slow neutron-gamma fission reaction in ^{238}Pu, de-excitation gamma-ray measurements, spontaneous fission half-life of ^{242m}Am, neutron diffraction, and several thermal neutron capture cross sections. R.L.

N67-33230 Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

THEORETICAL ASPECTS AND EXPERIMENTAL OF NEUTRONIC INTERACTION OF MULTIPLYING MEDIA [ASPECTS THEORIQUES ET EXPERIMENTAUX DE L'INTERACTION NEUTRONIQUE ENTRE MILIEUX MULTIPLICATEURS DE NEUTRONS]

Jean-Claude Mougniot Oct. 1965 93 p refs In FRENCH; ENGLISH summary
(CEA-R-2849)

A theoretical study of neutronic interaction of multiplying media is presented. The use of the surface multiplication constant and of the effective multiplication constant is considered. Three classical methods of interaction calculations are studied in parallel and the application of the K_{eff} method to problems of nuclear safety is discussed. Author

N67-33231# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

SELF-CONSISTENT TREATMENT OF INTERACTING SPIN WAVES AT FINITE TEMPERATURES [ETUDE A TEMPERATURE FINIE D'UN SYSTEME D'ONDES DE SPIN EN INTERACTION DANS UNE APPROXIMATION SELF-CONSISTANTE]

Micheline Bloch (Ph.D. Thesis—Paris Univ., 1965) 1966 78 p refs In FRENCH; ENGLISH summary
(CEA-R-2821) CFSTI: HC $3.00/MF $0.65

A spin wave theory is developed where account is taken of spin wave interactions at finite temperatures. The temperature dependence of the spin wave energies and of the magnetization is derived. The theory is developed for ferro-, ferri-, and antiferromagnets. Author

N67-33301# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON THE DETERMINATION OF ELECTROMAGNETIC FORM FACTORS OF THE SPIN 1 PARTICLE [OB OPREDELENII ELEKTROMAGNITNYKH FORM-FAKTOROV CHASTITSY SO SPINOM 1]

Doan Nhuong 1967 16 p refs In RUSSIAN
(JINR-P2-3227)

The electromagnetic vertex of the spin-1 particle is defined by four form factors: G_1, G_2, G_3, G_4 (the T-invariance is assumed to be violated). An experiment is suggested for determination of these form factors in different physical regions of the momentum transfer. Author (NSA)

N67-33342# Brookhaven National Lab., Upton, N. Y.

NUCLEAR STRUCTURE RESULTS DERIVED FROM INTERACTIONS OF PROTONS IN THE GeV REGION

Harry Palevsky [1967] 34 p refs Presented at the 2d Intern. Conf. on High Energy Phys. and Nucl. Struct., Rehovoth, Israel, 27 Feb.–3 Mar. 1967
(Contract AT(30-1)-GEN-16)
(BNL-11285; CONF-670207-3) CFSTI: HC $3.00/MF $0.65

Protons are used as a nuclear probe in experiments to determine nuclear structure. In these experiments an attempt is made to satisfy the conditions that the wavelength of the probe must be comparable to or smaller than the characteristic spacing of the nucleons, and that the energy resolution of the measuring system must be smaller than or comparable to the spacings of the energy levels of the nucleus under investigation. The hydrogen and the proton–helium-4 cross sections are discussed. NSA

N67-33343# Illinois Univ., Urbana. Dept. of Physics.

[ELEMENTARY PARTICLE PHYSICS RESEARCH] Annual Progress Report, Period Ending Apr. 1967

E. L. Goldwasser, A. Wattenberg, and G. M. Almy Apr. 1967 47 p refs
(Contract AT(11-1)-1195)
(COO-1195-91) CFSTI: HC $3.00/MF $0.65

The work of the counter and spark chamber groups and that of the bubble chamber group of the University of Illinois physics department is summarized. The topics covered are a summary of the scope and purpose of the project, the experimental program, development of facilities and equipment, and publications and abstracts of talks. NSA

N67-33427# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

CABIBBO-RADICATI SUM RULE AND PHOTODISINTEGRATION OF THREE-NUCLEON NUCLEI [PRAVILO SUMM KABIBBO-RADIKATII FOTORASSHCHEPLENIE TREKHNUKLONNYKH YADER]

S. B. Gerasimov 1967 5 p refs In RUSSIAN Submitted for publication
(JINR-P4-3222)

It follows from the validity of the Cabibbo–Radicati sum rule for the interaction of photons with ^{3}He and ^{3}H nuclei that the reaction of three-particle photodisintegration goes mainly through the $I=3/2$ state. Some consequences of this result are discussed. Author (NSA)

N67-33435# Brookhaven National Lab., Upton, N. Y.

FORWARD SCATTERING AMPLITUDES AT HIGH ENERGIES, DISPERSION RELATIONS, AND ASYMPTOTIC PREDICTIONS

S. J. Lindenbaum 24 Feb. 1967 49 p refs Presented at the 4th Conf. on Symmetry Principles at High Energies, Coral Gables, Fla., 25–27 Jan. 1967
(Contract AT(30-2)-GEN-16)
(BNL-11175; CONF-670108-2) CFSTI: HC $3.00/MF $0.65

A series of high accuracy determinations of the entire $\pi^{\pm}$–p forward scattering amplitudes were made, and a preliminary report of the results is presented. The proton–proton forward scattering was also measured in the 8 to 26 GeV/c range. Good agreement with theory is obtained. NSA

N67-33436# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.

EXCHANGE OF TENSOR MESONS IN ELASTIC NN-SCATTERING [OBMEN TENZORNYMI MEZONAMI V UPRUGOM NN-RASSEYANII]

L. S. Azhgirei and V. I. Chizhikov 1967 15 p refs In RUSSIAN Submitted for publication
(JINR-P02-3188)

The N–N scattering matrix amplitudes for the exchange of tensor ($J=2^+$) and pseudotensor ($J=2^-$) mesons are obtained. A partial wave decomposition is made and the expressions for the partial wave amplitudes are given. Author (NSA)

N67-33480# Brookhaven National Lab., Upton, N. Y.

MEASUREMENT OF $\pi^{\pm}$p BACKWARD SCATTERING BETWEEN 1.54 AND 2.04 GeV/c

A. S. Carroll, J. Fischer, A. Lundby, B. D. McDaniel, R. H. Phillips et al 1 May 1967 21 p refs
(BNL-11359) CFSTI: HC $3.00/MF $0.65

Measurements were made at 1.54 and 1.95 GeV/c for $\pi^+ + p$ scattering and at 1.88 and 2.04 GeV/c for $\pi^- + p$ scattering. Differential cross sections are given. Over most of the angular range ($-0.7 < \cos\theta_{cm}$) the $\pi^{\pm} + p$ the differential cross sections show very little evidence for the resonance found in previous total cross section measurements. But the results agree with other results in the same momentum interval. NSA

N67-33487# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

SPIN CORRELATION PARAMETERS A_{xx} AND A_{yy} MEASUREMENTS IN p–p SCATTERING FROM 11 TO 26 MeV [MESURE DES COEFFICIENTS DE CORRELATION DE SPINS A_{xx} ET A_{yy} DANS LA DIFFUSION p–p DE 11 A 26 MeV]

Philippe Catillon, Maurice Chapellier, and Denis Garreta Mar. 1967 75 p refs In FRENCH
(CEA-R-3193)

The A_{xx} and A_{yy} spin correlation coefficients of the proton–proton scattering were measured at the laboratory energies of 11.40, 19.15, 23.45, and 26.50 MeV for the center of mass scattering angle 90°. These measurements were made by scattering a polarized proton beam on a polarized proton target. Author (NSA)

N67-33502# California Inst. of Tech., Pasadena.

NUCLEAR ENERGY LEVELS OF ^{37}K

D. R. Goosman and R. W. Kavanagh Apr. 1967 102 p refs
(Contract Nonr-220(47))
(AD-654156) CFSTI: HC $3.00/MF $0.65

Approximately forty levels in 37K have been established via various nuclear reactions. Measurements of capture-gamma-ray energies with Ge(Li) counters have made possible the determination of several level energies with precisions ranging from 1 to 5 keV. The analogues in 37K of the first two excited levels in 37Ar were found as a closely spaced doublet at 1368 and 1380 keV excitation energy. The half-life of the latter has been measured electronically to be 9.6 plus or minus 1.4 nsec. The energies (in keV), spins, and parities of the lowest eight levels are given. Spin and parity assignments to other levels are also presented. Approximate values for the elastic and inelastic proton and gamma-ray widths of several levels have been determined. Evidence regarding the spins, parities, and widths of two candidates for the lowest T = 3/2 level is presented. The Q-value for 36Ar(p, gamma) is 1857.0 plus or minus 1.4 keV and the mass excess of 37K on the 12C = 0 scale is - 24799.6 plus or minus 2.7 keV. TAB

N67-33513# California Univ., Livermore. Lawrence Radiation Lab.

A CALCULATION OF THE AGE AND FAST EFFECT FOR MONOENERGETIC NEUTRONS IN Be and BeO

S. T. Perkins Mar. 1967 9 p refs
(Contract W-7405-ENG-48)
(UCRL-50229) CFSTI: HC $3.00/MF $0.65

The age and fast effect have been calculated for monoenergetic sources in Be and BeO by a multigroup solution of the moments equations. Recent nuclear data were utilized, including the breakup of the ^{9}Be (n,2n) reaction, as well as a detailed description of the differential cross sections. The energy-angle correlation was preserved for all reactions. The calculated ages to indium resonance (1.4 eV) for 14.1-MeV source neutrons were 128 and 134 cm^2 in Be (ρ = 1.85 g/cc) and BeO (ρ = 2.80 g/cc), respectively. Corresponding values for the fast effect were 2.59 in Be and 1.48 in BeO. Author (NSA)

N67-33514# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

GENERAL CONSIDERATIONS CONCERNING METASTABLE SPECIES [CONSIDERATIONS GENERALES SUR LES METASTABLES]

Guy Watel Mar. 1967 58 p refs In FRENCH
(CEA-Bib-89)

The metastable species are atoms, molecules, or ions in excited states whose lifetimes are sufficiently long for their return to ground states, under laboratory conditions, by the action of an outside phenomenon (electric or magnetic field, collision with other particles or the walls). This literature survey concerns the metastable atoms which have been most studied up to now: He, Ne, H, Hg, Ar, and Kr. Author (NSA)

N67-33518# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MEASUREMENT OF A NEUTRAL PARTICLE FLUX BY A THERMAL METHOD USING THE JUNCTION TEMPERATURE EFFECT [MESURE D'UN FLUX DE PARTICULES NEUTRES PAR UNE METHODE THERMIQUE METTANT A CONTRIBUTION L'EFFET DE TEMPERATURE DES JONCTIONS]

Anthime Caron Dec. 1966 74 p refs In FRENCH
(CEA-R-3094)

Among all the methods suitable for measuring neutral particle fluxes obtained by proton charge exchange in an organic gas, the thermal method was chosen. The energy imparted by the neutral particles to the target in the form of heat leads to the latter's temperature increasing; this temperature is usually followed with a thermocouple. In order to increase the sensitivity and the elegance of the apparatus the thermocouple was replaced by a junction whose characteristics are known to vary with temperature. A calibration is carried out using a beam of charged particles. The response obtained is linear. Measurements were made with a power of up to 1 MW; the accuracy increases with the energy provided; for 4 joules an accuracy of 10% is obtained. The apparatus may be improved in particular by extending the measurement range toward low power values, and by increasing the accuracy. Author (NSA)

N67-33566# Argonne National Lab., Ill.

FAST NEUTRON SCATTERING FROM THE 182, 184, and 186 ISOTOPES OF TUNGSTEN

D. Lister, A. B. Smith, and C. Dunford (Atomics Intern.) Jan. 1967 32 p refs
(Contract W-31-109-ENG-38)
(ANL-7288) CFSTI: HC $3.00/MF $0.65

The differential cross sections for the elastic and inelastic scattering of fast neutrons from ^{182}W, ^{184}W, and ^{186}W were experimentally determined at incident neutron energy intervals of $\leq$ 25 keV from 0.3 to 1.5 MeV. The excitation, by inelastic scattering, of states in ^{182}W at 102±5 and 327±10 keV; in ^{184}W at 110±5, 360±10, 901±10, 1003±10, and 1120±10 keV; and in ^{186}W at 121±5, 398±10, 738±10, 863±10, 942±10, and 1035±10 keV was observed. The differential elastic and inelastic scattering cross sections were measured at eight or more angles between 27 and 150° by means of a multiangle, fast time-of-flight system. The resolution was sufficient to resolve most of the scattered neutron groups. The experimental results were interpreted in terms of a deformed optical model, coupled-channel direct interaction, and Hauser–Feshbach theory. Good agreement with measurement was obtained when the effects of resonance width fluctuations and correlations were included. Author (NSA)

N67-33567*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

ELECTRON SHIELDING STUDIES Technical Progress Report, 1 Nov. 1966–31 Mar. 1966

C. Jupiter, R. Scalettar, G. Merkel, and W. Hunter, 8 Apr. 1966 38 p ref
(Contract NAS8-11304)
(NASA-CR-87143; GACD-7080; Rept.-1) CFSTI: HC $3.00/MF $0.65 CSCL 18F

As part of the experimental program, a 20-mCi Ce 137 internal conversion source was used to check the energy calibration of the 45-degree analyzing magnet. A number of thick target

bremsstrahlung spectra were obtained for incident electron energies of 10, 8, and 4 MeV electrons. Inflight positron annihilation spectra were produced by bombarding a thin Be target foil with 8, 8, and 10 MeV positrons. The annihilation spectra were used to determine the response function of the 5 in. by 5 in. NaI(Tl) scintillation spectrometer at 6, 8, and 10 MeV. Briefly described and illustrated is the assembly and installation of a stripseated continuous rotation scattering chamber for electron shielding experiments. Theoretical work included analyses and calculations for the Bethe eigenfunction solution to the electron transport problem, calculations of the relativistic inelastic electron cross sections, and computation of the bremsstrahlung cross sections with corrections to the electron–photon transport equations. K.W.

N67-33583# Columbia Univ., New York. Dept. of Physics.
PEGRAM NUCLEAR PHYSICS LABORATORIES Progress Report, Jan. 1966–Jan. 1967
Jan. 1967 221 p refs
(Contract AT(30-1)-GEN-72)
(NYO-GEN-72-132) CFSTI: HC $3.00/MF $0.65

Progress in a number of research projects in nuclear physics is reported. Topics covered include (1) neutron physics, (2) nuclear reactions with charged particles, (3) beta and gamma spectroscopy and its application to the study of nuclear structure and weak interactions, (4) muonic X-rays and nuclear structure, (5) neutron interactions with condensed matter, (6) kinetic theory of neutron gas in condensed matter, and (7) electronic instrument development. C.T.C.

N67-33628# California Univ., Livermore. Lawrence Radiation Lab.
NOTES ON MONTE CARLO METHOD FOR NON-LINEAR RADIATION TRANSPORT IN GENERAL AND ON THE INDIGO CODE IN PARTICULAR
Robert Nelson 12 Jan. 1967 13 p
(Contract W-7405-ENG-48)
(UCID-15133) CFSTI: HC $3.00/MF $0.65

A Monte Carlo code, INDIGO, designed to solve one-dimensional nonlinear radiation transport problems in real materials is described. The code works best in systems which are far from thermal equilibrium and which have extreme variations in cross sections over the ranges of interest in space or photon energy. It is handicapped in systems with extremely large absorption cross section, i.e., in systems where the mean free path for photons is very small compared to the space mesh, and in systems that are in thermal equilibrium. NSA

N67-33632# Aerospace Corp., San Bernardino, Calif. Labs. Div.
THE ATOMIC ABSORPTION CROSS SECTIONS OF LITHIUM AND SODIUM BETWEEN 600 AND 1000 ANGSTROM
Robert D. Hudson and Virginia L. Carter May 1967 22 p refs
(Contract AF 04(695)-1001)
(TR-1001(9260-01)-5; SSD-TR-67-92; AD-653991) CFSTI: HC $3.00/MF $0.65

The continuous atomic absorption cross section of lithium and sodium vapors was measured between 600 and 1000 A using photoelectric techniques. Curves and tables are presented of the atomic absorption cross section versus energy from their series limits to 600 A. A comparison is made between these results and recent theoretical estimates. The conclusion is that theory and experiment are in reasonable agreement for lithium over the entire energy range, but that agreement for sodium is poor at photon energies above 7 eV. Author (TAB)

N67-33644# Los Alamos Scientific Lab., N. Mex.
STOCHASTIC FORMULATIONS FOR NEUTRON TRANSPORT
George I. Bell [1967] 35 p refs Presented at Am. Math. Soc. Meeting, New York
(Contract W-7405-ENG-36)
(LA-DC-8706; CONF-670410-1) CFSTI: HC $3.00/MF $0.65

A review of stochastic neutron transport theory is presented with emphasis on the treatment of neutron transport as a Markov process. Various formulations of stochastic neutron transport theory are discussed, and the formulation of transport theory in terms of the probability generating function and of the lower-order moments of the probability distribution is outlined. NSA

N67-33652# Joint Inst. for Nuclear Research, Dubna (USSR).
KINEMATIC CHARACTERISTICS OF RESIDUAL NUCLEI IN CASCADE PROCESS AT PROTON ENERGY 660 MeV [KINEMATICHESKIE KHARAKTERISTIKI OSTATOCHNYKH YADER V KASKADNOM PROTSESSE PRI ENERGII PROTONOV 660 MeV]
V. I. Kochkin, V. O. Lozhkin, N. S. Mal'tseva, V. M. Mal'tsev, and Yu. P. Yakovlev 1967 21 p refs In RUSSIAN Submitted for publication
(JINR-P02-3201)

The results of calculations of the kinematics and excitation energy distributions of nuclei which remain after the cascade process is completed are given. The dependencies calculated are compared with experiment. Author (NSA)

N67-33688# Production Group, United Kingdom Atomic Energy Authority, Annon (Scotland).
THERMAL NEUTRON DEPTH DOSE DEPENDENCE ON BEAM AND PHANTOM SIZE FOR INCIDENT COLLIMATED BEAMS OF FAST NEUTRONS
R. C. Lawson and D. E. Watt 1967 20 p refs
(PG-774(CC)) CFSTI: HC $3.00/MF $0.65

Thermal neutron flux distributions produced at depth in tissue-equivalent liquid were measured for several collimated beams of incident fast neutrons with the object of obtaining data for calculating the $^{1}H(n,\gamma)^{2}D$ and $^{14}N(n,p)^{14}C$ doses delivered under conditions experienced frequently in radiobiological experiments. It is demonstrated that two group theory can be used to predict accurately the distribution of thermal neutron flux with depth and also the position of the peak value. A simple formula is given which permits the magnitude of the peak to be determined for any beam size between 5 cm and 17 cm diameter relative to that measured for one beam size. By a combination of these formulae a complete description of the thermal neutron flux at depth in tissue can be obtained. Studies on the magnitude of the flux distribution caused by changes in the phantom dimensions lead to the conclusion that the naturally occurring statistical variations about the size of the standard man phantom do not produce an important change in dose level. Author (NSA)

N67-33689# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
MULTIGROUP TRANSPORT PERTURBATION ALTAC CODE FOR THE PHILCO-2000 COMPUTER
M. Lemanska and S. Yiftah Dec. 1966 18 p refs
(IA-1106)

PERTR is a first order perturbation code based on the multigroup multiregion transport equation for spherical geometry. It is programmed for the Philco-2000 computer in ALTAC mnemonic language. The code may be used to calculate a change in k_{eff} obtained by perturbations of the material cross sections in a single region of a reactor. The total and angular fluxes and adjoint fluxes required by the perturbation formula are obtained by SNGTAC and SNGAD codes. Author (NSA)

N67-33678# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE PROBLEM OF ACCOUNT OF PAULI PRINCIPLE IN THE SCATTERING THEORY [K VOPROSU O TOZHDESTVENNOSTI CHASTITS V TEORII RASSEYANIYA]
T. G. Efimenko, V. P. Zhigunov, and B. N. Zakhar'ev 1967 16 p refs In RUSSIAN
(JINR-P4-3209)

A new method is suggested, in the framework of the multichannel formalism, to take into account the identity of scattered particles and those in the target. In contrast to the generally accepted method the system of coupled equations is formed not for resolution coefficients of a total wave function but of a function with truncated asymptotics. The problem is reduced then to the solution of a system of nonhomogeneous differential and algebraic equations instead of a system of integral-differential equations, which considerably simplifies the problem. Author (NSA)

N67-33693# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ON PROPERTIES OF THE ISOTOPE 102^{251}
G. N. Akap'ev, A. G. Demin, V. A. Druin, G. N. Flerov, Yu. S. Korotkin et al [1967] 8 p refs
(JINR-E7-3261)

The experimental data on the study of alpha-decay products of bombarding targets of ^{233}U, ^{235}U, and ^{239}Pu with ^{22}Ne, ^{20}Ne, and ^{16}O ions, respectively, are given. Experimental results indicate that the ^{251}No isotope has $T_{1/2}$ = 0.5 to 1.0 sec and E_α = 8.6 MeV. Author (NSA)

N67-33694# Cambridge Univ. (England). Cavendish Lab.
EVIDENCE FOR AN S = +1, I = 0 RESONANCE IN THE K^+-NUCLEON SYSTEM
A. A. Carter [1966] 10 p refs
(HEP-67-2)

The phase of the K^+-nucleon forward scattering amplitude is evaluated from dispersion relations. A qualitative difference is found between the I = 0 and I = 1 states. With assumptions for the background contributions to the amplitude, evidence is presented for an S = +1, I = 0 resonance. Author (NSA)

N67-33696# California Univ., Berkeley. Lawrence Radiation Lab.
DISSOCIATION OF HYDROGEN ON TANTALUM USING MODULATED MOLECULAR BEAM TECHNIQUE
Robert A. Krakowski (Ph.D. Thesis) Mar. 1967 290 p refs
(Contract W-7405-ENG-48)
(UCRL-17336) CFSTI: HC$3.00/MF$0.65

The dissociation of molecular hydrogen on hot tantalum surfaces has been investigated with a high vacuum apparatus using a modulated molecular beam–mass spectrometric technique. A modulated beam of molecular hydrogen, formed by effusion from a high pressure source, impinged upon the tantalum target. The reflected H_2 and H atoms emitted after surface dissociation were monitored by a mass spectrometer in the vacuum system. The beams were modulated and the products measured by a phase-sensitive detector to improve the signal-to-noise characteristics of the detection system. The degree of dissociation was studied as a function of the surface temperature, beam temperature and beam intensity. Experimental results have been analyzed in terms of phenomenological first and second order kinetic models. Within the pressure (3×10^{-7} torr) and temperature (1000 to 2500°K) ranges studied, all data agreed best with the first order mechanism, and yielded 65 kcal/mole for the hydrogen/metal bond energy. At a given temperature, dissociation increased with the beam temperature with an apparent activation energy of 1.4 kcal/mole, which was independent of the surface temperature. The rate of dissociation varied linearly with the beam intensity. Mixed hydrogen/deuterium beams were employed to investigate the isotope exchange reaction, and, within the sensitivity of the detection system, exchange did not take place. A simple kinetic model, which proposes a high adatom recombination probability before significant surface diffusion occurs, was proposed to explain the first order kinetics. Also, hydrogen solubility in the metal bulk has been considered as a possible source for the observed non-equilibrium behavior. Author (NSA)

N67-33697# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
CONVERSION ELECTRON SPECTRA OF ^{158}Ho [SPEKTR KONVERSIONNYKH ELEKTRONOV IZOTOPA Ho^{158}]
K. Ya. Gromov and F. N. Mukhtasimov 1967 8 p refs In RUSSIAN
(JINR-P6-3241)

The conversion electron spectra of ^{158}Ho were investigated using a permanent magnetic β spectrograph. In the study of ^{158}Ho decay, a number of new γ transitions were found; the multipolarity of a γ transition of the E2 type with the energy 320.6 keV is determined unambiguously. On the basis of these data, a scheme of ^{158}Dy excited levels is suggested, in which the levels with the energies 637.8(6.0$^+$); 994.5(0.0$^+$); 1084.8(2.0$^+$); 1278.6(4.0$^+$); 1314.2(5.2$^+$); 1476.2(6.2$^+$); 1894.7(4.4$^+$); and 2056 keV are introduced into the decay mode of ^{158}Ho for the first time. Author (NSA)

N67-33702# Argonne National Lab., Ill.
BULLETIN OF THE INFORMATION CENTER ON NUCLEAR DATA (FIRST ISSUE)
Oak Ridge, Tenn., AEC, Apr. 1967 442 p refs Transl. into ENGLISH of the book "Buylleten Informatsionnogo Tsentra po Yadernym Dannym (Vypusk Pervyi)" Moscow, Atomizdat, 1964 p 1–432 In ENGLISH and RUSSIAN
(ANL-TRANS-168) CFSTI: HC$3.00/MF$0.65

Parameters of elementary interactions of neutrons with nuclei are presented, together with reactor constants. The calculation of neutron cross sections by the optical model, using computers is discussed, as is data processing for single-crystal fast-neutron scintillation spectrometry. NSA

N67-33708# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
TO THE PROBLEM OF DISPERSION SUM RULES [K VOPROSU O DISPERSIONNYKH PRAVILAKH SUMM]
V. G. Kadyshevskii, R. M. Mir-Kasimov, and A. N. Tavkhelidze 1967 11 p refs In RUSSIAN
(JINR-P2-3198)

It is shown that the dispersion sum rules can be used for the mapping of the relations between high energy cross sections into the low energy region. Author (NSA)

N67-33709# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
A SYSTEM WITH A HAMILTONIAN AS A TIME-DEPENDENT QUADRATIC FORM OF $\hat{x}$ AND $\hat{p}$ [SISTEMA S GAMIL'TONIANOM V VIDE ZAVISYASHCHEI OT VREMENI KVADRATICHNOI FORMY OT $\hat{x}$ I $\hat{p}$]
N. A. Chernikov 1967 20 p refs In RUSSIAN
(JINR-P2-3223)

The solution of the Schrödinger equation is expressed algebraically through the solution of the classical Hamiltonian equations in the case when the Hamiltonian is a quadratic form of coordinates and momenta, and the coefficients of this form depend arbitrarily on time. For such a system the Fock representation is introduced. The results obtained are useful for the quantum field theory formulation in an arbitrary space–time. Author (NSA)

N67-33713# Oak Ridge National Lab., Tenn.
EXTERMINATOR-2: A FORTRAN IV CODE FOR SOLVING MULTIGROUP NEUTRON DIFFUSION EQUATIONS IN TWO DIMENSIONS
T. B. Fowler, M. L. Tobias, and D. R. Vondy Apr. 1967 94 p refs
(Contract W-7405-ENG-26)
(ORNL-4078) CFSTI: HC $3.00/MF $0.65

Exterminator-2 is a Fortran IV version of the code Exterminator with major improvements. The code embodies all the features of Exterminator and, in addition, can be used to search for criticality directly or indirectly by varying nuclide concentrations, take into account equilibrium Xe effects, and compute adjoint fluxes and do perturbation calculations. Variable dimensioning techniques were used in programming the code that allow easy adaptation to any computer with a Fortran IV compiler and a minimum core size of approximately 64K words. The code contains no assembly language coding. Succeeding cases require only those input-data that are different from the input for the preceding case, and the code uses I/O devices during the iterative part of the calculation only when core storage is exhausted. Author (NSA)

N67-33725# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DISPERSION SUM RULES FOR NN-SCATTERING AND NN̄-SCATTERING [DISPERSIONNYE PRAVILA SUMM DLYA NN-I NN̄-RASSEYANIYA]
V. G. Pisarenko 1967 13 p refs In RUSSIAN
(JINR-P2-3253)

By help of dispersion sum rules the parameters of the high energy NN- and NN̄-scattering are connected with the cross section integrals in the low and middle energy region. Author (NSA)

N67-33740# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik.
MEASUREMENTS OF EFFECTIVE (RESONANCE-SHIELDED) NEUTRON CROSS SECTIONS IN THE keV REGION
H. Miessner and E. Arai Oct. 1966 16 p refs Sponsored by EURATOM
(EURFNR-209F; KFK-451)

Neutron absorption and transport cross sections were measured for Pb and ^{238}U at 30 keV and for ^{238}U at 7.5 keV by observing the decay of short pulses of nearly monoenergetic neutrons in assemblies of Pb and U. NSA

N67-33741* Volt Technical Corp., Washington, D. C.
PROPORTIONAL COUNTER FILLED WITH A MIXTURE OF XENON AND ISOPENTANE
G. E. Kocharov, V. O. Naydenov, and V. M. Shuvayev 14 Aug. 1967 4 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz (Moscow), v. 28, no. 10, 1964 p 1725–1727
(Contract NAS5-12487)
(NASA-CR-87328; ST-EXP-INS-10637) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Parameters K and U, characterizing a gas, are computed for proportional counters filled with a mixture of xenon and isopentane. The influence of the space charge on the gas amplification parameters is studied for the case of γ-quantum energy. It was found that $P_L/P_K \cong 1.1$, where P_L and P_K are the probabilities of capture of orbital electrons from L- and K-shells. Author

N67-33776# California Inst. of Tech., Pasadena.
A STUDY OF LEVELS IN ^{23}Mg
J. Dubois and L. G. Earwaker Apr. 1967 50 p refs
(Contract Nonr-220(47))
(AD-654155) CFSTI: HC $3.00/MF $0.65

Levels in 23Mg with excitation energies up to 6.8 MeV have been investigated by magnetic analysis of the alpha particles from the reaction 24Mg(3He, alpha)23Mg at bombarding energies between 6 and 12 MeV. Between 4.4 and 6.8-MeV excitation energy, 16 new levels were found in 23Mg. Angular distributions of the emitted alpha particles were measured and from DWBA analysis l-values for the picked up neutrons were obtained. The particle-gamma angular correlation method of Litherland and Ferguson was used to obtain additional information on the spin assignments of the levels as well as branching and mixing ratios of the gamma-ray transitions. The following spin and parity assignments have been established: 0.451 MeV 5/2(+), 2.048 MeV 7/2 (3/2), 2.356 MeV 1/2(+), 2.788 MeV (1/2, 3/2)(-), 2.904 MeV (3/2, 5/2)(+), 3.792 MeV 3/2(-), 4.353 MeV 1/2(+), 5.289 MeV (3/2, 5/2)(+), and 5.992 MeV (1/2, 3/2)(-). The experimental results are compared with those obtained for 23Na and the predictions of the collective model. Author (TAB)

N67-33778# Oak Ridge National Lab., Tenn. Neutron Physics Div.
MEASUREMENT OF THE NEUTRON FISSION AND CAPTURE CROSS SECTIONS FOR ^{233}U IN THE ENERGY REGION 0.4 TO 1000 eV
L. W. Weston, R. Gwin, G. De Saussure, R. W. Ingle, R. R. Fullwood et al 26 Apr. 1967 63 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1751) CFSTI: HC $3.00/MF $0.65

The neutron capture and fission cross sections for ^{233}U were measured simultaneously in the neutron energy range from 0.4 to 1000 eV. The data are presented in graphical, tabular, and integral form. Comparisons with previously published data, using similar and different methods, are given. Author (NSA)

N67-33830# Johann-Wolfgang-Goethe-Universitat, Frankfurt Am Main (West Germany). Institut fuer Angewandte Physik.
THE MULTIPLE SCATTERING OF GAMMA-RAYS IN MEDIA WITH LOW ATOMIC NUMBER [DIE VIELFACHSTREUUNG VON GAMMA-STRAHLUNG IN MEDIEN NIEDRIGER ORDNUNGSZAHL]
A. Schaerschmidt Bad Godesberg, W. Germany, Bundesmin. fuer Wiss. Forschung, Jan. 1967 112 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-09)

The energy spectra of multiply scattered gamma radiation in sand from point sources of ^{60}Co and ^{137}Cs were measured with a scintillation spectrometer and were corrected according to the matrix method. A theory was developed which distinguishes three groups of radiation: the primaries; the hard, forward-running secondaries; and the softer, diffusing secondaries. Both experiments and theory lead to a quasiequilibrium. The quality of the secondary radiation becomes independent of the distance from the source, but the intensity of the secondaries relative to the primaries grows with distance. An exact knowledge of the scattered radiation is important for solving problems of radiation protection. Author (NSA)

N67-33840# Atomics International, Canoga Park, Calif.
EVALUATION OF HEAVY EVEN-EVEN NUCLIDE ELASTIC AND INELASTIC CROSS SECTIONS BY MEANS OF A NONSPHERICAL OPTICAL MODEL
Charles L. Dunford 15 Mar. 1967 23 p refs
(Contract AT(04-3)-701)
(NAA-SR-MEMO-12314) CFSTI: HC $3.00/MF $0.65

The heavy even–even isotopes were investigated with a combined nonspherical potential optical model and compound-nucleus theory. Compound-nucleus theory provides a method for treating all the reaction cross sections [fission, capture, (n,n'), (n,2n)]. An analysis of ^{238}U and ^{232}Th for which considerable

data is available has justified the usefulness of this approach to evaluation. The non-spherical optical model permits the evaluator to separate the elastic and inelastic components of a measured angular distribution for these isotopes. Combined with an appropriate compound-nucleus model, it is possible to differentiate between conflicting sets of ^{238}U capture data within the range of 10 to 100 keV. Author (NSA)

N67-33841# Rice Univ., Houston, Tex. Bonner Nuclear Labs.
NUCLEAR REACTION STUDIES USING POLARIZED ^3He TARGETS AND BEAMS
G. C. Phillips 2 Dec. 1966 18 p refs Presented at Conf. on Polarized Targets and Sources, Saclay, France
(Contract AT(40-1)-1316)
(ORO-1316-22; CONF-661205-4) CFSTI: HC $3.00/MF $0.65

The experimental requirements of polarized ^3He targets are discussed, together with a system for producing polarized $^3He^+$ beams using optical pumping of rf discharges. Some studies involving polarized ^3He targets are reviewed, and some asymmetry measurements for proton elastic scattering by polarized ^3He are summarized. NSA

N67-33844# California Univ., Berkeley. Lawrence Radiation Lab.
RECENT WORK ON REGGE POLES AND THE THREE-BODY PROBLEM
Stanley Mandelstam 7 Nov. 1966 37 p Presented at the 2d Japan. Summer Inst. of Theoret. Phys., Oiso, Japan
(Contract W-7405-ENG-48)
(UCRL-17250) CFSTI: HC $3.00/MF $0.65

Three lectures are presented on recent work on Regge poles and the three-body problem. Topics discussed are the three-body N/D equations, features of Regge trajectories with three-particle and multiparticle intermediate states, and the asymptotic behavior of amplitudes for backward scattering. NSA

N67-33856# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
DETERMINATION OF SPINS OF ^{165}Ho NEUTRON RESONANCES [OPREDELENIE SPINOV NEITRONNYKH REZONANSOV Ho^{165}]
V. P. Alfimenkov, V. I. Lushchikov, V. G. Nikolenko, Yu. V. Taran, and F. L. Shapiro 1967 12 p refs In RUSSIAN
(JINR-P3-3208)

The transmission of polarized neutrons through a polarized Ho target was measured by time-of-flight method with the help of a neutron spectrometer with a resolution of 25 ns/m. From these measurements the spins were determined for 18 excited states of the ^{166}Ho compound nucleus. Author (NSA)

N67-33867# Pennsylvania Univ., Philadelphia.
$\pi^- p \rightarrow \pi^- \pi^+ n$ AT 8 GeV/c
H. Yuta, A. Baker, R. Ehrlich, and W. Selove 23 Jul. 1966 20 p refs Presented at the 13th Intern. Conf. on High Energy Phys., Berkeley, Calif., 1966
(Contract AT(30-1)-2171)
(NYO-2171-218; CONF-660808-24) CFSTI: HC $3.00/MF $0.65

The results of interactions of the type $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ are given. These results were obtained from 100,000 pictures taken in the bubble chamber. Decay angular distributions for the ρ^0 and the f^0 bands and production distributions in momentum transfer are shown. The data are consistent with the existence of the g(1765). NSA

N67-33880# Princeton Univ., N. J. Palmer Physical Lab.
THE SPINS AND MOMENTS OF Sb^{117} AND Sb^{118m}
Andrew D. Jackson, Jr. (Ph.D. Thesis) Mar. 1967 122 p refs
(Contract AT(30-1)-937; Grant NSF GP-579)
(PUC-937-250) CFSTI: HC $3.00/MF $0.65

The spins and hyperfine structures (HFS) of ^{117}Sb (2.7 hr) and ^{118m}Sb (3.5 min) were determined using conventional atomic-beam magnetic resonance techniques. These isotopes were produced by (p,n) reactions on enriched tin targets in the Princeton University cyclotron. ^{117}Sb was made with the internal proton beam and was transferred to an off-line atomic-beam apparatus. ^{118m}Sb was produced directly in the oven chamber of an on-line beam apparatus using the external proton beam. The spin measurements gave $I_{117} = 5/2$ and $I_{118m} = 1$. The measured HFS constants are $A_{117} = 237.8(2)$ MHz, $B_{117} = -5.4(4)$ MHz, and $|A_{118m}| = 545(24)$ MHz. The corresponding magnetic dipole and electric quadrupole moments are $\mu_{117} = +2.672(10)$ nm, $|\mu_{118m}| = 2.45(12)$ nm, and $Q_{117} = -0.29(3)$ b. The results of first-order configuration-mixing corrections to the magnet moments using both zero-range and realistic force matrix elements are discussed. Author (NSA)

N67-33882# Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina).
DETERMINATION OF THE THREE CONVERSION COEFFICIENTS IN THE DECAY OF Au^{198} WITH SEMICONDUCTOR COUNTERS
H. E. Bosch and E. Szichman Dec. 1966 18 p refs
(Grant DA-ARO-49-092-66-G121)
(NP-16672)

A setup for determining conversion coefficients by means of different arrangements of semiconductor detectors (both lithium-drifted silicon and germanium) and scintillation counters is presented. The conversion coefficients corresponding to the three transitions in ^{198}Hg were measured. Singles electron conversion and gamma spectra were recorded, deriving the value of the conversion coefficient for the 1.083-MeV transition taking into account the value obtained for that of the 0.412-MeV transition. Beta continuum-electron conversion coincidences were measured with two lithium-drifted silicon detectors, and the K-conversion coefficient for the latter transition was obtained. Gamma-gamma coincidences with a lithium-drifted germanium detector and a conventional scintillation counter were done, yielding the value of the K-conversion coefficient for the 0.671-MeV transition. The relative intensities of the gamma rays detected with a lithium-drifted germanium counter are given. Author (NSA)

N67-33886# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
EMPIRICAL FORMULAS FOR PARTICLE PRODUCTION IN P–Be COLLISION BETWEEN 10 AND 35 GeV/c
J. R. Sanford and C. L. Wang 1 Mar. 1967 30 p refs
(BNL-11299) CFSTI: HC $3.00/MF $0.65

Empirical formulas which give quantitative representations of the secondary particle production in p–Be reactions based on the characteristics of the experimental data between 10 and 34 GeV/c incident proton momenta are constructed. Except for certain kinematical constraints the approach is therefore purely algebraic rather than physical. It is found that aside from the goodness of fits to the momentum spectrum the most remarkable achievement of the formula obtained is its prediction of the meson (π) multiplicities. NSA

N67-33907# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
MEASUREMENT OF THE PROCESS $K^- + P \rightarrow K^0 + N$ AT 8 GeV/c
Andrew Buffington (Ph.D. Thesis) Dec. 1966 132 p refs
(Contract AT(30-1)-2098)
(MIT-2098-301; TR-83) CFSTI: HC $3.00/MF $0.65

The MASCOT system was used to measure kaon elastic charge-exchange scattering at an incident momentum of 8 GeV/c with a liquid hydrogen target. The measured total cross section is

71 ± 21 microbarns, based on analysis of a fifth of the data. An angular distribution of the process was also measured. The details of design and construction of the MASCOT system as well as its calibration and application to this particular reaction are presented.
Author (NSA)

N67-33910# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
PHOTOPRODUCTION OF STRANGE PARTICLES AT ENERGIES UP TO 5.8 GeV
G. Harigel, G. Horlitz, E. Lohrmann, H. Meyer, G. Wolf et al Mar. 1967 19 p refs
(DESY-67/6)

Photoproduction of strange particles was studied in a hydrogen bubble chamber exposed to a bremsstrahlung beam with a maximum photon energy of 5.8 GeV. There were 1,200,000 pictures evaluated resulting in a total of 709 events with visible strange particle decays. The interactions $\gamma + p \rightarrow \gamma + K^+$, $\gamma + p \rightarrow \Sigma^0 + K^+$, $\gamma + p \rightarrow \Sigma^+ + K^0$, $\gamma + p \rightarrow \Lambda + K^+ + \pi^0$ (π^0 ...), $\gamma + p \rightarrow \Lambda + K^0 + \pi^+$, $\gamma + p \rightarrow \Sigma^+ + K^+ + \pi^-$, $\gamma + p \rightarrow \Sigma^- + K^+ + \pi^+$, $\gamma + p \rightarrow \Lambda + K^+ + \pi^+ + \pi^-$ are considered.
NSA

N67-33919# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
ON STABLE METHODS OF MATRIX FACTORIZATION FOR BLOCK-TRI-DIAGONAL MATRICES. PART 2: APPLICATION TO MULTIGROUP DIFFUSION EQUATIONS
Reimar Froelich 31 Oct. 1966 64 p refs
(Contract AT(04-3)-167)
(GA-7164, Pt. 2) CFSTI: HC $3.00/MF $0.65

The inhomogeneous multigroup diffusion equations for one, two, and three dimensions are considered in a difference equation formulation. With a proper ordering of the unknowns the systems of linear equations have block-tri-diagonal coefficient matrices—this is demonstrated in several figures. The reconditioning method, also known as stabilized march out technique, is shown to be applicable to these equations in the subcritical case. In the supercritical case necessary and sufficient conditions for the applicability of the reconditioning method are derived. The solution of the homogeneous multigroup diffusion equations can be obtained with fission power or Wielandt iterations, in solving repeatedly inhomogenbous multigroup diffusion equations with the same coefficient matrix but with different inhomogeneous parts. In the case of Wielandt iterations, and especially for the calculation of higher modes, it is shown that the general reconditioning method is applicable in avoiding reconditioning transformations at certain locations.
Author (NSA)

N67-33920# Basel Univ. (Switzerland).
PARITY AND RESIDUAL EFFECTS IN COLLECTIVE LEVELS OF SPHERICALLY SYMMETRIC NUCLEI [PARITAET UND RESTWECHSELWIRKUNG IN KOLLEKTIVEN NIVEAUX SPHAERISCH SYMMETRISCHER KERNE]
Ulrich Goetz [1966] 35 p refs In GERMAN
(NP-16596)

The interpretation of the lower energy levels of spherically symmetric nuclei as collective states gives for the parity the rule $(-1)^P = (-1)^J$. How far this parity rule can be established from the assumptions of the shell model and two-nucleon residual interaction was investigated. It was shown that a rigid derivation in the case of a residual interaction, under consideration of a spin-spin coupling, is possible, but that in a general central potential in the Hamilton operator terms also occur violate the rule. The relative magnitude of such terms in dependence on the direction of the interaction should be estimated on the basis of a Gaussian potential.
Author (NSA)

N67-33921# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
THE A(θ) ASYMMETRY IN ELASTIC 635 MeV pp-SCATTERING
V. S. Kaelev, V. S. Nedezhdin, V. I. Satarov, and R. Ya. Zulkarnaev 1967 8 p refs Submitted for publication
(JINR-E01-3194)

The results of the A(θ) asymmetry measurements of elastic pp-scattering are described as being completely due to the totally polarized beam. The measurements were performed at 635 MeV in the angle range from 28 to 90° (cms). Earlier pp-scattering phase shifts are improved by using both the results and those of other experiments. In searching for solutions beginning from random values three solutions with $l_{max} = 5$ and two solutions with $l_{max} = 4$ are obtained. Thus, in the energy range analyzed, no evidence for the existence of a single phase-shift solution is obtained.
Author (NSA)

N67-33922# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
FORMATION OF THE MAGNETIC FIELD IN THE CENTRAL REGION OF THE SYNCHROCYCLOTRON TO INCREASE VERTICAL FOCUSING [FORMIROVANIE MAGNITNOGO POLYA V TSENTRAL'NOI OBLASTI SINKHROTSIKLOTRONA S TSEL'YA UVELICHENIYA VERTIKAL'NOI FOKUSIROVKI]
V. I. Danilov, V. B. Mukhina, and A. N. Safonov 1967 21 p refs In RUSSIAN
(JINR-P09-3181)

Some variants are considered on how to improve the vertical focusing of particles by formation of axially symmetrical magnetic fields with a large drop-off in the central region of the synchrocyclotron as well as by creation of an azimuthally varying magnetic field. It is shown that the use of a magnetic field variation near the center to increase the vertical focusing without considerable diminution of the dee aperture is not advisable, since one does not succeed in providing a sufficiently great variation amplitude at small radii.
Author (NSA)

N67-33927# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.
ANALOG RESONANCE MODULATION OF RADIATIVE NUCLEAR REACTIONS
S. Fallieros Feb. 1967 14 p refs Presented at Intern. Conf. on Electromagnetic Interactions at Low and Intermediate Energies, Dubna, USSR, Feb. 1967
(Contract AT(30-1)-3525)
(NYO-3525-16; CONF-670203-2) CFSTI: HC $3.00/MF $0.65

An investigation of the properties of (p,γ) reactions proceeding through an isobaric analog resonance is summarized. The reaction $^{88}Sr(p,\gamma)^{89}Y$ is treated as an example. A description is given of the (p,γ) reaction that takes into account the possibility that the reaction can proceed either through the formation of an analog resonance and its subsequent radiative deexcitation or through the giant dipole resonance that modulates the T-lower background that surrounds the analog state.
NSA

N67-33949# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
THE MEASUREMENT OF W, THE AVERAGE ENERGY TO PRODUCE AN ION PAIR, FOR RECOIL NUCLEI IN CARBON DIOXIDE
J. W. Leake Jan. 1967 30 p refs
(AERE-R-5130) CFSTI: HC $3.00/MF $0.65

Preliminary measurements of W, the average energy required to create one ion pair in a gas, are presented for carbon and oxygen recoil nuclei produced by the elastic scattering of neutrons in carbon dioxide gas. The observations cover a range of recoil

energies, from 100 keV to 2.9 MeV, for which there are no published data. The accuracy of the measurements is not high; the results are thought to be 10 to 20% higher than the true values because of the effects of columnar recombination. Three semitheoretical expressions relating the value of W to the energy (or velocity) of the ionizing particles are discussed and compared with the published experimental data for argon and the present results for carbon dioxide. Author (NSA)

N67-33951# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INVESTIGATION OF THE ACCURACY OF APPROXIMATE METHODS IN SUPERFLUID NUCLEAR MODEL [IZLUCHENIE TOCHNOSTI PRIBLIZHENNYKH METODOV SVERKHTEKUCHEI MODELI YADRA]
P. Boshan, A. Pavlikovski, and V. Rybarska 1967 14 p refs In RUSSIAN
(JINR-P4-3124)

A model was considered: the interaction of six particles with the potential which are located on five two-fold degenerate equidistant levels. The influence of a multipole–multipole term was investigated by varying parameters. The energy eigenvalues are exactly found in the framework of this simple model. The results are compared with approximate values obtained under the u–v transformation and by the method of approximate second quantization. Author (NSA)

N67-33957# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
THE REACTION $pp \rightarrow pn\pi^+$ AT 10 GeV/c AND THE OPE MODEL
H. C. Dehne, J. Diaz, K. Stroemer, A. Schmitt, W. P. Swanson (Physik Staatsinst.) et al Feb. 1967. 15 p refs
(DESY-67/4)

The reaction $p + p \rightarrow p + n + \pi^+$ and the process $p + p \rightarrow N^{++}_{(1238)} n$ were measured at 10 GeV/c. The OPEM is compared with the isobar production and agreement with the data is better than a factor of two. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-32762# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.
EXPERIMENTAL OBSERVATION OF NON-LINEAR COUPLING BETWEEN SLOW AND FAST WAVES IN A PLASMA WAVEGUIDE
P. Hedvall 23 Feb. 1967 15 p refs
(Contract AF 61(052)-895)
(SR-17; RADC-TR-67-323; AD-652835) CFSTI: HC $3.00/MF $0.65

Non-linear coupling between slow and fast waves in a circular waveguide partially filled with a plasma was studied experimentally. The waveguide was short-circuited to form a resonant cavity. A slow, symmetrical wave was launched on the plasma column and propagated into the cavity. By feeding pump power into the TM_{010} resonant mode of the cavity a non-linear coupling between the slow wave and the TM_{011} resonant mode could be achieved when the frequency of the slow wave was equal to the frequency difference between the two resonant modes. With a pump power of 1 watt an over-all coupling coefficient of the order of −40 dB was obtained. Author (TAB)

N67-32807# University Coll., Cork (Ireland). Dept. of Electrical Engineering.
MICROWAVE STUDIES OF IONIZATION PHENOMENA IN GASEOUS DISCHARGES Final Scientific Report, 1 Jan. 1965–31 Dec. 1966
M. C. Sexton 15 Mar. 1967 23 p refs
(Grant AF-EOAR-46-65)
(AFOSR-67-1112; AD-652503) CFSTI: HC $3.00/MF $0.65

Electron density decay over the range 10 to the 11th power to 8 x 10 to the 9th power/c.c. in the afterglows of helium and argon plasmas has been measured using a 3 cm microwave free-space interferometer. Results indicate the dominance of ambipolar diffusion (mobility) at pressures less than 1 torr whereas electron-ion recombination became significant above this pressure. In contrast with previous work carried out at lower densities and smaller plasma dimensions, the existence of non-thermal electron energies is postulated on the basis of the mobility and recombination parameters measured. A conversion frequency of 376p2 from atomic to molecular argon was also measured, concerning which no experimental study had previously been reported. Summaries of two Interim Scientific Reports, already published, are given dealing with microwave studies of ionization rates in d.c. plasmas and harmonic generation at microwave frequencies using varactor diodes, in addition to four publications mainly concerned with electronic circuitry associated with the plasma research. Author (TAB)

N67-32883# General Electric Co., Philadelphia, Pa. Missile and Space Div.
HYPERSONIC RAREFIED PLASMA FLOWS Final Report, Period Ending Oct. 14, 1966
Sinclaire M. Scala 15 Oct. 1966 78 p refs
(Contract AF 49(638)-1638)
(AFOSR-67-0805; AD-649836) CFSTI: HC $3.00/MF $0.65

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1. DISCRETE ORDINATE TECHNIQUE FOR THE NON-LINEAR BOLTZMANN EQUATION WITH APPLICATION TO PSEUDO-SHOCK RELAXATION M. Wachman and B. B. Hamel 29 p refs (See N67-32884 19-25)

2. A KINETIC THEORY FOR SOURCE FLOW EXPANSIONS WITH APPLICATION TO THE FREE JET B. B. Hamel and D. R. Willis 38 p refs (See N67-32885 19-12)

N67-32884# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A DISCRETE ORDINATE TECHNIQUE FOR THE NON-LINEAR BOLTZMANN EQUATION WITH APPLICATION TO PSEUDO-SHOCK RELAXATION
Murray Wachman and Bernard B. Hamel *In its* Hypersonic Rarefied Plasma Flows 15 Oct. 1966 29 p refs Presented at the 5th Intern. Rarefied Gas Dyn. Symp., Oxford, Jul. 1966 (See N67-32883 19-25)

A numerical method for the solution of the nonlinear Boltzmann equation of hard sphere molecules is developed, in which approximations are made only in the sense of numerical truncations. The distribution function is evaluated at a three-dimensional grid of distinct velocity points. A five-fold gaussian quadrature is performed to evaluate the five derivatives at these points. The distribution function is then evaluated at $t_o+\Delta t$ by solving a system of first order ordinary differential equations. In the nonlinear case the grid is no longer closed, and the procedure to circumvent the difficulty is described. This technique is applied to the problem of nonlinear, homogeneous, pseudo-shock relaxation. Author (TAB)

N67-32886* RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
SATELLITE CYCLOTRON HARMONIC RESONANCES

I. P. Shkarofsky and T. W. Johnston Mar. 1965 205 p refs (Contract NASw-957) (NASA-CR-87058; RCA Res. Rept.-7-801-35) CFSTI: HC $3.00/MF $0.65 CSCL 20I

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1. THE DIELECTRIC TENSOR NEAR CYCLOTRON HARMONICS I. P. Shkarofsky 46 p refs (See N67-32887 19-25)

2. THE DISPERSION OF WAVES IN CYCLOTRON HARMONIC RESONANCE REGIONS WITH APPLICATION TO THE ALOUETTE I. P. Shkarofsky 83 p refs (See N67-32888 19-25)

3. TIME DECAY FOR CYCLOTRON HARMONICS I. P. Shkarofsky and T. W. Johnston 25 p refs (See N67-32889 19-25)

4. ALOUETTE CYCLOTRON HARMONICS OBSERVATIONS AND RESULTS T. W. Johnston 24 p refs (See N67-32890 19-25)

N67-32887* RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.

THE DIELECTRIC TENSOR NEAR CYCLOTRON HARMONICS

I. P. Shkarofsky *In its* Satellite Cyclotron Harmonic Resonances Mar. 1965 46 p refs (See N67-32886 19-25)

The relativistic expression for the dielectric tensor obtained by Trubnikov is simplified in the very weakly relativistic limit at and near electron cyclotron harmonics. Wave numbers parallel to magnetic field are included, leading to relativistic damping when this wave number is zero and to cyclotron damping when it is sufficiently large. The transition is shown. Collisional damping is neglected. The dielectric elements given here are also applicable to cases of complex ω and real k. This situation arises in Alouette reception because of an initial time value problem. For this application, the analytic continuation of a complicated function is provided, and the tracks are investigated where it is real for complex ω. Author

N67-32888* RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.

THE DISPERSION OF WAVES IN CYCLOTRON HARMONIC RESONANCE REGIONS WITH APPLICATION TO THE ALOUETTE

I. P. Shkarofsky *In its* Satellite Cyclotron Harmonic Resonances Mar. 1965 83 p refs (See N67-32886 19-25)

The dispersion of waves near electron cyclotron harmonics is investigated including the first order, wave numbers parallel to the magnetic field. The proper relativistic form for the dielectric tensor elements is applied. Distinct different behaviors result depending on whether the wave number or frequency is taken to be complex. In the former case, the waves near the Appleton–Hartree values are localized and a gap exists between them and the plasma wave. In the latter case, no gap exists except as one tends to zero wave number where the dispersion curve indicates a rapid rise in frequency above the harmonic. Matching points of satellite velocity to the wave group velocity are found for the extraordinary and ordinary waves. The relativistic formulation is compared with the nonrelativistic one. Author

N67-32889* RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.

TIME DECAY FOR CYCLOTRON HARMONICS

I. P. Shkarofsky and T. W. Johnston *In its* Satellite Cyclotron Harmonic Resonances Mar. 1965 25 p refs (See N67-32886 19-25)

The calculation is discussed of the time behavior associated with the frequency singularities resulting from pinches in wave number integration. The pinches occur when an integration contour in wave number space is pinched between poles. This technique is then applied, for the Alouette situation, to the singular case for very small wave number when the satellite and group velocity are equal. The relevant Alouette signal is found to be indistinguishable from galactic noise in a time of order 20 μsec, well before the Alouette receiver is turned on. The cyclotron resonance must be found elsewhere, probably in the coupling resonances or in the Bernstein modes. Author

N67-32890* RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.

ALOUETTE CYCLOTRON HARMONICS OBSERVATIONS AND RESULTS

T. W. Johnston *In its* Satellite Cyclotron Harmonic Resonances Mar. 1965 24 p refs (See N67-32886 19-25)

The Alouette results are summarized and discussed. A non-mathematical exposition is given of the course of mathematical analysis pursued and the results obtained. The numerical result obtained for the particular case of small wave number gave a signal which was one hundred times too small, so concentration of future work on coupling resonance is urged. In view of the apparent importance of parallel resonance, the physical basis of this mechanism is explained. Recommendations for future work complete the exposition. Author

N67-32891# Oxford Univ. (England). Dept. of Engineering Science.

WAVES IN BOUNDED PLASMAS

Donald H. McKay 30 Mar. 1967 98 p refs (Contract AF 61(052)-734) (Rept.-1024.67; AFOSR-67-1101; AD-652505) CFSTI: HC $3.00/MF $0.65

The first part of the report is on magnetohydrodynamic waves in inhomogeneous plasma cylinders. The second part gives some general properties and a computer program for propagation in homogeneous dissipative anisotropic cylinders. The remainder of the report discusses modes related to the low-frequency electron cyclotron waves (helicons) found in infinite gaseous plasmas. Author (TAB)

N67-32899# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut fuer Energieumwandlung und Elektrische Antriebe.

SPECTROSCOPIC MEASUREMENTS ON AN ELECTRODELESS PLASMA ACCELERATOR [SPEKTROSKOPISCHE MESSUNGEN AN EINEM ELEKTRODENLOSEN PLASMA BESCHLEUNIGER]

R. Koehne Aug. 1966 25 p refs In GERMAN; ENGLISH summary (NP-18694; DLR-FB-66-53)

Spectroscopic measurements on a pulsed electrodeless plasma accelerator are reported. The purpose of these measurements is to estimate the loss of radiation energy within the visible range and to compare it with the applied electric energy. The conductivity is calculated from electron temperature and density. The energy loss of radiation was less than 1% of the electric energy. The conductivity of the He plasma was more than $10^2(\Omega m)^{-1}$. Author (NSA)

N67-32928# Commissariat a l'Energie Atomique Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

HOLLOW-CATHODE ARCS: LITERATURE SURVEY [LES ARCS A CATHODE CREUSE. MISE AU POINT BIBLIOGRAPHIQUE]

Claude Breton Mar. 1967 28 p refs In FRENCH Prepared for EURATOM (CEA-BIB-88)

Arc discharges have been studied for a large number of years in a wide range of operational conditions. The idea of using hollow electrodes, a magnetic field and constant axial gas-stream appears to have resulted from work carried out at Oak Ridge in about 1955. Since then, hollow cathode or anode arcs have been further developed. Phenomena connected with the cathode have, however, been little studied. The object of this work is to review this particular field of a type of arc having remarkable properties.
Author (NSA)

N67-32985# Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki.
EXPERIMENTS WITH A HIGH-CURRENT PULSED ARC [EKSPERIMENTY S SIL'NOTOCHNOI IMPUL'SNOI DUGOI]
S. G. Alikhanov, I. K. Konkashbaev, and B. S. Estrin 1966 18 p refs In RUSSIAN
(NP-16869)

A pulsed, high-current arc in hydrogen has been investigated experimentally yielding data on a high-temperature dense plasma. The discharge tube, the measurement of plasma conductivity, the arrangement of the appropriate magnetic fields, the determination (by piezoelectric sensor) of the gas kinetic pressure of the plasma, and the photographic and spectrographic registration of the data are described. A semitheoretical processing of data shows that, following an unstable starting period, the discharge becomes stable and is characterized by a large amount of impurities. During the current maximum, half of the gas kinetic plasma pressure is due to the pinch effect. The plasma had a density of $n_i \approx 10^{18}$ cm^{-3} for a T_{max} of $\approx 2 \times 10^5$°K. The course of the energy decay seems to indicate that the radiation is highly absorbed by multiply charged impurity ions.
NSA

N67-32976# Avco-Everett Research Lab., Everett, Mass.
UNSTEADY FLOW IN THE SHOCK TUBE MHD GENERATOR
F. J. Fishman Jun. 1967 28 p refs
(Avco-Everett Res. Rept.-271)

In order to obtain some insight into unsteady magnetohydrodynamic channel flow, the flow in an idealized shock tube generator is investigated theoretically. The test gas is assumed to have a constant scaler electrical conductivity, σ, while the driver gas is nonconducting. The constant area Faraday channel begins at the diaphragm, and is finely segmented with equal external loads for each electrode pair, so that a constant load parameter $\alpha = E_x/uB$ is achieved. The treatment is limited to weak shocks (initial pressure ratio across the diaphragm less than about five), but is valid for arbitrary interaction parameters, so that the flow can be followed to its eventual decay. The entire flow field is computed in some detail. The unsteady character of the flow is exhibited by the general slowing of the flow, although fluid particles away from the interface do experience a period of acceleration, as would be expected in a steady subsonic flow with dissipation. The electric power extracted, which initially rises linearly with the length of the test gas, peaks at a value of about half that estimated from the initial flow persisting for a time ω_e^{-1}, but decays only very slowly thereafter, so that very substantial amounts of energy are delivered to the load.
Author

N67-33010*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PLASMAPAUSE AND DIFFUSION ACROSS FIELD LINES
H. G. Mayr Mar. 1967 17 p refs
(NASA-TM-X-55858; X-621-67-120) CFSTI: HC $3.00/MF $0.65
CSCL 20I

The latitudinal variation of oxygen and hydrogen ion composition in the magnetosphere is discussed, and a discrepancy between observed and calculated ion composition in the upper latitudes is investigated. Mechanisms for regular and irregular diffusion across field lines are studied. It is shown that the irregular diffusion mechanism postulated by Bohm quantitatively accounts for the density plateau and its relation to the ion composition at high latitudes.
N.E.N.

N67-33032# London Univ. (England). King's Coll.
PLASMA PHYSICS IN AN ASTROPHYSICAL ENVIRONMENT Final Scientific Report, 15 Nov. 1965–14 Nov. 1966
Ian W. Roxburgh Dec. 1966 12 p
(Contract AF 61(052)-908)
(AFCRL-67-0195; AD-653211) CFSTI: HC $3.00/MF $0.65

The stabilizing influence of a magnetic field on a differentially rotating star has been investigated and it has been demonstrated that a field of one gauss or more can prevent the development of a high degree of non-uniform rotation during the early contactional stages of a star's evolution, and so prevent the formation of double stars. The effect of uniform rotation on the non-radial modes of oscillation of a star has been investigated and the resulting oscillation frequencies and velocities calculated. This work has been extended to non-uniformly rotating stars and results obtained so far indicate that differential rotation can cause instability. The effect of uniform rotation on the internal structure and observational properties of stars has also been actively investigated and results are given demonstrating these changes for a wide range of masses and rotational velocities. The transport of energy through low density surface layers of stars has been investigated for distorted stars, and the variation of emergent energy with position on the surface is given.
TAB

N67-33041# California Univ., Livermore. Lawrence Radiation Lab.
SUPERCONDUCTING BASEBALL COIL FOR PLASMA CONFINEMENT
Carl D. Henning and Clyde E. Taylor 21 Mar. 1967 17 p refs Presented at the Intern. Conf. on the Present Status of and Prospective Develop. in Cryog. Eng., Kyoto, 9–15 Apr. 1967
(Contract W-7405-ENG-48)
(UCRL-70380; CONF-670409-1) CFSTI: HC $3.00/MF $0.65

Most large-scale controlled-fusion experiments of the dc mirror–machine type can advantageously use superconducting coils. These coils are not simple solenoids, but have a shape that produces a magnetic well of minimum field strength in a roughly spherical volume. Design information is presented on baseball-coil shapes, including field configuration, force distribution, and inductance. Experience with such superconducting-coil systems illustrates the particular problems of using these coils for controlled-fusion experiments. In addition, a natural-circulation liquid–helium system is described that is presently being used in the baby-baseball neutral-injection experiment.
Author (NSA)

N67-33063# Illinois Univ., Chicago. Coordinated Science Lab.
INCOHERENT SCATTERING OF MICROWAVES FROM ENHANCED DENSITY FLUCTUATIONS IN A DC-DISCHARGE
Wayne Elbert Carr May 1967 78 p refs
(Contract DA-28-043-AMC-00073(E))
(R-352; AD-653521) CFSTI: HC $3.00/MF $0.65

Radiation of 9375 MHz is incident on a cylindrical neon discharge enclosed in a 1 inch square waveguide and incoherent scattering in the upper sideband is investigated. Scattering is observed in the backward and forward directions from the naturally enhanced density fluctuations in two electron plasma modes for gas pressures between 3.8X0.001 Torr and 8.0X0.001 Torr. The measured electron mode frequencies are in general agreement with other experiments. The enhancement, varying between 30 and

8000 times the estimated thermal value is correlated over most of the pressure range to excess super-thermal electrons present in the discharge, as measured by a Langmuir probe. Author (TAB)

N67-33054# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CYLINDRICAL ELECTRIC ARC THEORY TAKING INTO ACCOUNT ENERGY TRANSFER BY RADIATION
V. N. Vetlutskiy, A. T. Onufriyev, and V. G. Sevast'yanenko 22 Mar. 1967 25 p refs Transl. into ENGLISH from the book "Raschet Tsilindricheskoy Elektricheskoy Dugi s Uchetom Perenosa Energii Izlucheniyem" Moscow, 1965 p 1–28
(FTD-MT-65-544; AD-653559) CFSTI: HC $3.00/MF $0.65

The article contains calculations of arc in argon and hydrogen stabilized by cooled walls of channel with consideration of radiation with usage of theoretically calculated dependences describing transport properties of plasma. Composition of argon and hydrogen plasma was determined by formulas of chemical equilibrium, taking into account lowering of ionization potential. Coefficients of electrical and thermal conductivity were conducted by formulas of kinetic theory. Elementary processes are listed which cause hydrogen plasma to radiate energy. The results of calculations on argon and hydrogen are expounded in detail. Author (TAB)

N67-33067# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
MACROSCOPIC FINITE RESISTIVITY INSTABILITIES—A LITERATURE SURVEY
Helmut Friedel Apr. 1967 9 p refs
(Contract F61052-67-C-0014)
(SR-46; AFOSR-67-1086; AD-652242) CFSTI: HC $3.00/MF $0.65

The paper gives a short review of the present theoretical work on macroscopic MGD resistive instabilities. Particularly, pinch and multipolar configurations are considered in addition to general equilibrium configurations. Author (TAB)

N67-33092# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
SCALING PARAMETERS FOR LOW DENSITY FLOWING PLASMAS. PART I. ELECTRON BEAM STUDIES OF THE GAS-SURFACE INTERACTION PROCESS. PART II Semiannual Technical Summary Report, For Work to Mar. 1, 1967
Jacob H. de Leeuw and J. Barry French 5 Jun. 1967 14 p refs
(Contract Nonr-4073(00))
(AD-653366) CFSTI: HC $3.00/MF $0.65

Work is reported on measurements in the cryo-pumped plasma tunnel, which extends the capabilities to more rarefied conditions. Work is also reported on electron beam-plasma interactions aimed at developing a new diagnostic technique. Earlier work established the feasibility of using pulsed electron beams to measure molecular velocity distribution functions based on the metastable molecule time-of-flight technique. During the present period, work has proceeded on an intensive quantitative investigation of all aspects of the technique which it is necessary to understand if it is to be used on various gases or in various velocity regimes. Work has also proceeded on an experiment to use this technique to look at the velocities of high energy beam molecules reflected from known surfaces. Author (TAB)

N67-33204# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HALL EFFECT IN CHANNEL WITH SECTIONALIZED ELECTRODES [EFFEKT KHOLLA V KANALE S SEKTSIONIROVANNYMI ELEKTRODAMI]
I. M. Tolmach and N. N. Yasnitskaya 28 Mar. 1967 29 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR. Energ. i Transp. (Moscow), no. 5, 1965 p 91–104
(FTD-MT-66-49; TT-67-62119; AD-653542) CFSTI: HC $3.00/MF $0.65

The authors found distribution of current density during flow of electrically conductive liquid in channel with arbitrary number of sectionalized electrodes of finite dimensions (Hilbert boundary value problem for a band). For a very large number of electrodes the problem may be considered periodic. For this case the authors obtained distribution of current density through doubly periodic functions. Formulas were given for arbitrary constants entering in solution and depending on circuit of connection of electrodes. Dependences of efficiency, useful power, and voltage due to ratio of width of flow to pitch of section were plotted. Author (TAB)

N67-33210# California Univ., Livermore. Lawrence Radiation Lab.
RADIATION AND PLASMA PHYSICS
K. Nishimura *In its* Phys. Dept. Rept., Jun.–Sep. 1966 Sep. 1966 p 51–55 refs (See N67-33206 19-23)

Radiation and plasma physics research involved an integrated system of 16 lasers to study plasma production by high-powered pulsed lasers. The shape of the evolving plasma was of primary interest and it was found that when the total energy of the focused laser pulses was a few joules (near the threshold for plasma formation) the resulting plasma became approximately spherical within 5×10^{-8} sec. The effect of various parameters on the output energy from a Q-spoiled ruby oscillator was studied. Also studied was the problem calculating the rate of energy transfer between ions and electrons in a plasma. R.Li.

N67-33218# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
RESULTS OBTAINED FROM THE "BILLE EN TETE A" EXPERIMENT [RESULTATS EXPEMENTAUX SUR BILLE EN TETE "A"]
Paul Evrard, Jean Jacquinot, Christian Leloup, Jean-Pierre Poffe, and Francois Waelbroeck Jul. 1966 111 p In FRENCH; ENGLISH summary
(CEA-R-3000; EUR-2792.f)

Collisions of plasma puffs, whose characteristics (density and velocity) were varied in a broad domain are studied in a homogeneous longitudinal magnetic field. It has been verified that the puffs meet head on. We show that collisions of dense ($n_i \geq 4\times10^{14}$ cm^{-3}) and relatively slow ($v_\phi \leq 10^7$ cm.s) puffs are efficient, i.e., the initial kinetic energies of the puffs are converted into thermal energy of the ions in the resulting plasma. Faster and less dense puffs interact little (incomplete conversion of kinetic into thermal energy). In the magnetic bottle of Bille-en-Tete A (mirror ratio 4000/2000 G), the collision of two low density puffs leads to the capture of one liter of plasma with a density $n_i \approx 2\times10^{13}$ cm^{-3} and an ionic temperature $T_i \approx 10^8$ °K. The e-folding time of the plasma diamagnetism reaches 50 to 150 μs; no flute instabilities are detected. Author

N67-33227# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
RESONANCE PROBE [LA SONDE A RESONANCE]
Dimitri Lepechinsky, Andre Messiaen, and Paul Rolland 1966 31 p refs In FRENCH; ENGLISH summary
(CEA-R-2945)

After a brief review of papers recently published on the resonance probe as a tool for plasma diagnostics, the main features of the theory proposed by one of us are recalled. In this theory the geometry of the resonator formed by the probe, the ion sheath and

the plasma is explicitly taken into account with the quasi-static and cold plasma approximations. Some new results emerging from this theory are indicated and a comparison with experimental data obtained with a spherical probe placed in a quiescent mercury-vapour plasma is made. A good quantitative agreement has been observed, indicating that the theory is satisfactory and justifying the assumptions involved. Nevertheless it appears that in some cases experimental results can only be interpreted when non-collisional damping phenomena are taken into consideration.
Author

N67-33284# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Energiewandlung und Elektrische Antriebe.
ENERGY, ELECTRICAL CONDUCTIVITY AND DIELECTRIC TENSOR OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELDS [ENERGIEAUFNAHME, ELEKTRISCHE LEITFAEHIGKEIT UND DIELEKTRIZITAETSKONSTANTE VON GELADENEN TEILCHEN IN ELEKTRISCHEN UND MAGNETISCHEN FELDERN]
Siegfried Kelm Jun. 1967 48 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-37)

The drift velocity of electrons and ions which is caused by electric and magnetic fields in a plasma, was determined. The mean energy of the charged particles which they gain in the plasma between two collisions, could also be evaluated. The electrical conductivity was calculated by simple formulae. The electrical conductivity and the dielectric constant become a tensor under well-known conditions. The dependence on the frequency of the electric and magnetic field, on the cyclotron frequency and on the collision frequency was represented and described for the elements of the conductivity and dielectric tensor. It was assumed in the calculations that the electric and magnetic fields were constant or alternating in time or that there were electromagnetic waves.
Author

N67-33286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF COEFFICIENT OF THERMAL CONDUCTIVITY OF A CESIUM PLASMA
L. P. Zarkova and B. I. Stefanov 21 Mar. 1967 20 p refs Transl. into ENGLISH of the book "Eksperimental'noye Opredeleniye Koeffitsiyenta Teploprovodnosti Tseziyevoy Plazmy" Moscow, 1965 p 1-16
(FTD-MT-65-529; AD-653555) CFSTI: HC$3.00/MF$0.65

The coefficient of thermal conductivity of cesium vapor in the temperature range of 1600°-2400°K and the pressure of 15 mm Hg are measured. In the region of 1000°-1600°K, the results do not depend on pressure, but there is a sharp growth of the coefficient of thermal conductivity observed caused by the ionization heat transfer depending on pressure. This excess ionization coefficient electron velocity distribution function is obtainable from the form of Landau damping acting on the plasma resonance, whereas collisional damping is usually stronger than cyclotron damping for the other resonances. Also the damping expression for the upper hybrid at high plasma densities suffers from complexities in analysis. All resonances are useful to yield electron density and temperature from the dispersion effects. Author (TAB)

N67-33282# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Gas Ionizzati.
PROPAGATION OF ION WAVES IN A PLASMA FLOW TOWARDS A WALL
A. Cavaliere, F. Engelmann, and A. Sestero Mar. 1967 44 p refs Sponsored in part by EURATOM
(LGI-67-4) CFSTI: HC$3.00/MF$0.65

The propagation of ion-acoustic waves in a weakly ionized, bounded plasma is investigated, typically with reference to discharge tubes: where there is an equilibrium between volume ionization and surface recombination at the walls. A macroscopic description is used which accounts for effects of ion collisions and finite ion temperature. Special attention is paid to the problem of the wave absorption at the plasma boundary. It results that the ion-acoustic waves are strongly absorbed at the plasma boundary, whenever the electrostatic boundary conditions require the formation of a space-charge sheath near the walls (implying the existence of a transonic point of the ion flow at the limit between the sheath and the plasma). Author (ESRO)

N67-33295# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT HIGH-FREQUENCY OSCILLATIONS OF ELECTRONIC PLASMA
A. I. Akhiyezer and Ya. B. Faynberg 31 Mar. 1967 16 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow) v. 21, no. 11, 1951 p 1262-1269
(FTD-HT-66-494; AD-653966) CFSTI: HC$3.00/MF$0.65

The paper discusses the interaction of a beam of charged particles with an electron plasma. It is shown that the state of the beam, which is characterized by constant and uniform speed and density, turns out to be unstable. If such a beam goes into a plasma fluctuations in density and speed are formed in it and these are propagated in the form of a wave with increasing amplitude. The longitudinal field connected with it also has the character of a wave with increasing amplitude. Author (TAB)

N67-33300# Air Force Academy, Colo. Frank J. Seiler Research Lab.
EXPERIMENTS ON TRANSVERSE IONIZING MHD SHOCK WAVES Final Scientific Report
Charles F. Stebbins May 1967 100 p refs
(SRL-67-0006; AD-654013) CFSTI: HC$3.00/MF$0.65

The jump conditions across a transverse ionizing MHD shock wave, where the magnetic field is in the plane of the shock, are examined. The simple conservation laws, in conjunction with Maxwell's laws and the equation of a state, yield three jump equations in four unknowns. The ionizing wave, then, requires an additional descriptive relationship for a unique solution to the jump equations to exist. Several theories which attempt to supply this missing relationship are examined including the theory of Lyubimov and Kulikovskii and later, Chu, where the internal structure of the shock, itself, supplies the missing relationship. In particular, Lyubimov and Kulikovskii show, for appropriate ratios of the thermal diffusivity to the magnetic diffusivity, that for low speed shock waves the magnetic field compression across the shock is unity and the jump equations reduce to the ordinary Rankine-Hugoniot relations. For high speed shock waves, the magnetic field compression is equal to the gas compression across the wave, and the jump equations became exactly the magnetohydrodynamic jump relations. Furthermore, intermediate speed shocks experience a magnetic field compression between 1 and rho sub 2/rho sub 1.
Author (TAB)

N67-33337# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ELECTRON ENERGY DISTRIBUTION IN A WEAKLY IONIZED PLASMA [DISTRIBUTION DES ENERGIES ELECTRONIQUES DANS UN PLASMA FAIBLEMENT IONISE]
Claude Cesari (Ph.D. Thesis—Paris Univ., France) Mar. 1967 141 p refs In FRENCH
(CEA-R-3165)

Theoretical and experimental studies were made to view the type of distribution function for the electron energies existing

in a positive-column-type cold laboratory plasma having an ionization rate of between 10^{-8} and 10^{-7}. The theoretical analysis, based on the imperfect Lorentz model and taking into account inelastic collisions, is developed from the Boltzmann equation. The experimental method for making an electrostatic analysis of the electronic energies makes use of a Langmuir probe used in conjunction with a transistorized electronic device. A comparison between the experimental and theoretical results yields information concerning the mechanisms governing electron energy transfer on a microscopic scale. Author (NSA)

N67-33349# New York State Univ., Syracuse. Magneto-Fluid Dynamics Div.

CONSTRUCTION OF STEADY-STATE HYDROMAGNETIC DYNAMOS. II: THE SPHERICAL CONDUCTOR

Stephen Childress 30 Mar. 1967 54 p refs

(Grant AF-AFOSR-815-67)

(MF-54; AFOSR-67-0976; AD-653603) CFSTI: HC $3.00/MF $0.65

The steady-state kinematic dynamo problem in a homogeneous sphere with concentric spherical fluid core is considered. The existence of a class of solenoidal dynamos satisfying a no-slip condition on the core boundary is proved by perturbing the discrete spectrum of a simpler self-adjoint comparison problem. The dynamos are of the form q = q(1) + q(2) + q(3) where q(1) is spatially periodic, q(2) is zero except in a neighborhood of the boundary of the core, and q(3) is an arbitrary sufficiently small motion. Author (TAB)

N67-33388*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

BEAM-PLASMA INTERACTIONS

J. R. Apel *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Dependence of wavelength, frequency, and growth rates of waves upon density, stream velocity, and magnetic field strength was investigated in regions where simple exponential wave growth was observed. The dispersion relation describing the waves in the actual experiment was studied using a computer program for finding the complex eigenvalues of the dispersion equation; and the nonlinear effects in the beam plasma experiment were studied. Measurements were made of harmonic generation, the behavior of harmonics in space, and the frequency spectrum of the waves; and the saturation of the spatially growing waves was investigated as a function of beam voltage. M.W.R.

N67-33389*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

PLASMA FLOW IN A MAGNETIC FIELD

W. R. Powell and T. R. Whyte *In its* Res. and Develop. Programs Mar. 1967 2 p (See N67-33361 19-34)

New facilities for spectroscopic analysis of plasmas were acquired and developed. A photographic survey of the visible region of the spectrum indicates the presence of carbon, oxygen, and possibly silicon impurities in the plasma. A special housing was constructed that allows the photographic plate of the spectrograph to be replaced by several photoelectric detectors. This permits the temporal development of several spectral intensities to be measured simultaneously for the same plasma. A special instrument has been designed and built that permits the intensity of light in 14 adjacent stripe to be measured. This instrument will be used in conjunction with a monochromator to measure the width of broad spectral lines in order to infer the plasma density and to measure the size and intensity distribution across a plasma column. Author

N67-33419# Royal Inst. of Tech., Stockholm (Sweden). Div. of Electron and Plasma Physics.

PENNING DISCHARGE IN A STRONGLY INHOMOGENEOUS MAGNETIC MIRROR FIELD

N. Hopfgarten, R. B. Johansson, B. Nilsson, and H. Persson 25 May 1967 9 p refs

(Rept.-67-11) CFSTI: HC $3.00/MF $0.65

Theoretical investigations of a collisionless plasma in an inhomogeneous magnetic field have shown that a considerable potential difference can exist along a magnetic line of force, provided there is anisotropy in the velocity distributions of ions and electrons. An attempt is being made to produce such a parallel electric field in a Penning discharge in a strongly inhomogeneous magnetic mirror field. A number of measurements were made with a time-varying magnetic field. Then the voltage is applied on the electrode system in advance, and the discharge starts when the magnetic field grows. Here a few results are reported which were obtained with a magnetic field, which is constant in time. In this case the discharge is started by the application of the electrode voltage. Author (ESRO)

N67-33463*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

DEDUCTION OF REENTRY PLASMA PROPERTIES ABOUT MANNED ORBITAL SPACECRAFT FROM RADIO SIGNAL ATTENUATION DATA

Paul W. Huber Washington, NASA, Aug. 1967 37 p refs

(NASA-TN-D-4118) CFSTI: $3.00 CSCL 20I

Correlations of electron concentration deduced from flight reentry attenuation measurements from the Mercury and Gemini manned orbital reentries with those derived from theoretical models of reentry plasmas were made. Based on these correlations, the following conclusions were derived with regard to the properties of the near wake plasmas and their role in the reentry signal loss phenomenon: (1) The reentry signal loss profile typically associated with these spacecraft is attributable in large part to the effects of ablation impurities in the near wake viscous flow regions. (2) The separated flow region generally exhibits the highest afterbody flow field electron concentration as a result of the following principal factors: (a) the finite rate electron–ion recombination along afterbody inviscid flow streamlines is very effective in reduction of levels of electron concentration which are much above 10^{11} cm^{-3}, and (b) the high static enthalpy and long flow dwell time associated with the separated flow region allow for large ionization of alkali ablation impurities introduced upstream in the heat shield boundary layer. (3) The levels of ablation impurities in the near wake viscous flow regions are generally much lower than those levels near the ablating heat shield surface with attached flow. (4) Variation of these apparent mixing factors with Reynolds number based on body diameter indicates that sheer layer transition occurs at a Reynolds number of about 8×10^5 and that the afterbody flow is attached at Reynolds numbers less than about 2×10^4. (5) The introduction of small quantities of liquid spray into the separated flow can result in large decreases in the temperature and electron concentration of this region. S.C.W.

N67-33468# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

ELECTROSTATIC STABILITY OF PLASMAS OF FINITE LENGTH. GENERAL THEORY [STABILITE ELECTROSTATIQUE DES PLASMAS DE LON GUEUR FINIE. THEORIE GENERALE]

Michel Cotsaftis Feb. 1967 52 p refs In FRENCH

(CEA-R-3156; EUR-3244.f; EUR-CEA-FC-371)

With the simple model of a plane geometry, taking into account the finite extension of the plasma along the magnetic field and the existence of a cold plasma between the hot plasma and exterior conducting plates, as well as the reflection of the

particles at the mirrors, the curvature of field lines and the density gradient, the equation for electrostatic perturbations, supposing $\beta << 1$, is given with the most general particle equilibrium state. This equation is solved. It contains new terms related to the mirror effect, having poles for all the linear combination with integer numbers of the various frequencies of the system for each species of particles. It no longer admits, as previously, a "free wave" solution. Furthermore, the general dispersion relation is given, applying the boundaries conditions, from which the electrostatic stability of the system can be studied. This will be done elsewhere, but some properties of open systems are indicated. Author (NSA)

N67-33498# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN CHARACTERISTICS OF A HIGH-FREQUENCY INDUCTION GAS DISCHARGE AND PECULIARITIES OF ITS APPLICATION FOR SYNTHESIS OF REFRACTORY DIELECTRIC CRYSTALS

K. K. Voronin, Z. M. Gol'dfarb, A. V. Donskoy, S. V. Dresvin, V. S. Kulbnikin et al 22 Mar. 1967 17 p refs Transl. into ENGLISH of the book "Nekotoryye Kharakteristiki Vysokochastotnogo Induktsionnogo Gazovogo Razyada i Osobennosti Yego Primeneniya Diya Sinteza Tugoplavkikh Kristallov Dielektrikov" Moscow, 1965 p 1–12

(FTD-MT-65-530; AD-653556) CFSTI: HC $3.00/MF $0.65

The article describes an experiment in which a plasma gun is used to synthesize crystals. High-frequency argon plasma guns with water-cooled quartz walls are investigated and the plasma jet produced by a gun with sectional metal walls is examined. Synthesis of crystals in a plasma jet by the Verneuil method and the zone recrystallization procedure is discussed. TAB

N67-33503# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF SPECTROSCOPIC METHODS FOR DIAGNOSTICS OF LOW TEMPERATURE PLASMA

M. A. Yel'yashevich, L. I. Grechikhin, and L. I. Kiselevskiy 22 Mar. 1967 14 p refs Transl. into ENGLISH of the Monograph "Primeneniye Spektroskopicheskikh Metodov Diya Diagnostiki Nizkotemperaturnoy Plazmy" Moscow, 1965 p 1–8 Presented at the Intern. Congr. on Theoret. and Appl. Chem.

(FTD-MT-65-539; TT-67-62115; AD-653557) CFSTI: HC $3.00/MF $0.65

The report states methods of determining concentrations of charged particles in low temperature plasma according to measurement of broadening of spectral lines caused by quadratic Stark effect, measurements of intensities of forbidden spectral lines which appear under action of intermolecular electric fields, and intensities of autoionization spectral lines. (TAB)

N67-33509# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.

PLASMA DIFFUSION ACROSS THE MAGNETIC SURFACES OF A TOROIDAL FIELD

B. Lehnert 13 Jun. 1967 15 p refs

(Rept.-67-12) CFSTI: HC $3.00/MF $0.65

The quasi-stationary equilibrium is studied for a plasma confined by a toroidal field having magnetic surfaces which do not coincide with the surfaces of constant magnetic field strength. For rotational transforms of moderate strength the magnetic gradient drift of the guiding centers is found to produce a macroscopic flow of plasma across the magnetic surfaces. This effect tends to establish a pressure gradient along the magnetic field and leads to a longitudinal plasma flow. As a consequence, a circulation of plasma will take place between regions of different pressures which leads to a type of transverse diffusion. The corresponding diffusion coefficient is formally equivalent to that suggested for Bohm diffusion, but the present mechanism is not connected with oscillations or instabilities and is merely due to a deviation from equilibrium in a higher approximation. It should be present also in certain minimum average-B systems. Author (ESRO)

N67-33516# Commissariat a l'Energie Atomique, Fontenay-aux-Roses. Centre d'Etudes Nucleaires.

SPECTRAL Lyα, Lyβ, AND Hα LINES SHAPES FOR THE H ATOM IN THE PRESENCE OF A MAGNETIC FIELD IN A PLASMA [PROFILS DES RAIES SPECTRALES Lyα, Lyβ, ET Hα DE L'ATOME H EN PRESENCE D'UN CHAMP MAGNETIQUE DANS UN PLASMA]

Hoe Nguyen, Hans-Werner Darwin, and Louis Herman Feb. 1967 93 p refs In FRENCH

(CEA-R-3161)

Numerical data are given of the line shapes of Lyα, Lyβ, and Hα for the following parameters: $1 \times 10^2 \leq H$ [gauss] $\leq 1.2 \times 10^5$; $1 \times 10^{15} \leq N$ [cm^{-3}] $\leq 1 \times 10^{18}$; and $1 \times 10^4 \leq T$ [°K] $\leq 4 \times 10^4$; where H = magnetic field strength, N = density of plasma ions, and T = electron temperature. Author (NSA)

N67-33604* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

EFFECTS OF PLASMA ON ELECTROMAGNETIC WAVES AND DEVICES

In its [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 90–105 refs (See N67-33593 19-10)

The theoretical investigation of the waves produced by an electric dipole in a warm, anisotropic, single-fluid, collisionless plasma, in which there is no bulk motion was completed. The equations were reduced to a single inhomogeneous linear differential equation, a Green's function for the equation was proposed, and the resulting equation was Fourier-transformed and solved to produce an integral representation for the field, requiring six integrations for the solution. Five of these integrations were performed analytically, resulting in an exact closed-form integrand, which was then integrated numerically for a specific set of the parameters which define the specified plasma. Field intensity diagrams were plotted in the plane of the dipole, using a radius of 10 meters, in the far-field region. Three modes resulted, roughly analogous to the ordinary, extraordinary, and electroacoustic waves found by the cold anisotropic analyses and warm isotropic analyses previously done. Author

N67-33807* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

ELECTROHYDRODYNAMIC GENERATION OF CHARGED PARTICLE BEAMS

S. B. Sample *In its* [Res. Areas in the School of Elec. Eng. of Purdue Univ.] Jan. 1967 p 119 *ref* (See N67-33593 19-10)

The electrical spraying of liquids from capillary tips is being studied in an effort to develop techniques for generating beams of extremely uniform microscopic charged particles. It is expected that these particle beams will prove useful in the study and control of the surface properties of solids, and will provide means for accurately controlling the deposition of thin films on solid substrates. A theoretical analysis of the equilibrium shape and characteristic frequencies of an electrically stressed liquid meniscus is being carried out. This analysis is based on an earlier theoretical treatment of the static and dynamic behavior of liquid drops in electric fields. It is expected that this work will make it possible to predict under what conditions the electrical spraying process becomes periodic (i.e., under what conditions the emitted particles are uniform in mass and charge). In addition to the theoretical analysis, equipment is presently being acquired for an experimental study of

electrical spraying from capillaries under the influence of intense time-varying electric fields. Initially, these studies will be performed with water in an air environment, and will be intended to check the theoretically predicted characteristic frequencies of the meniscus at the capillary tip. Author

N67-33621 Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MOTION OF A PARTICLE IN A RADIAL SPACE-CHARGE FIELD AND IN AN AXIAL MAGNETIC FIELD [LE MOUVEMENT D'UNE PARTICLE DANS UN CHAMP DE CHARGE D'ESPACE RADIAL ET UN CHAMP MAGNETIQUE AXIAL]

Ernesto Canobbio and Umberto Finzi (Phys. Inst., Milan) Oct. 1966 14 p ref In FRENCH; ENGLISH summary
(CEA-R-3103)

The motion of a charged particle in an axial uniform steady magnetic field, under the action of a radial space charge is calculated. A cylindrical symmetric charge distribution similar to the one which is observed in HF plasma accelerators is assumed. The particle motion is discussed with the method of effective potentials. A radial acceleration of ions is shown to be possible if the space charge density is sufficiently high. The displacement of the turning points of the trajectories due to the electrostatic field is calculated in the low plasma density approximation. Finally a HF circularly polarized electric field is introduced, the shift in cyclotron resonance is calculated and a low frequency resonance is found to be possible. Author

N67-33629# Princeton Univ., N. J. Plasma Physics Lab.

A VARIATIONAL PRINCIPLE FOR STATIONARY MAGNETOHYDRODYNAMIC EQUILIBRIA

John M. Greene and Erik T. Karlson Oct. 1966 28 p refs
(Contract AT(30-1)-1283)
(MATT-478) CFSTI: HC $3.00/MF $0.65

A variational principle of Hamilton's type is constructed for stationary, bounded magnetohydrodynamic flows, also known as stationary equilibria. The chief object is to find how much information must be given in order to have a well-posed problem. The results indicate, but do not rigorously prove, that five suitably chosen functions of a single variable and the location of a rigid conducting boundary define a unique stationary flow. Comparison is made with other variational principles. NSA

N67-33638# Royal Inst. of Tech., Stockholm (Sweden).

RESEARCH IN ELECTRON PHYSICS AND PLASMA PHYSICS AT THE ROYAL INSTITUTE OF TECHNOLOGY, STOCKHOLM, SWEDEN

R. Bostroem and L. Lindberg, ed. May 1967 42 p
(Rept.-67-04) CFSTI: HC $3.00/MF $0.65

Described are projects in space physics, cosmogony, and cosmology. Outlines are given of research activities in plasma confinement; plasma speed in partially ionized gases; plasma in parallel electric and magnetic fields; solar wind magnetosphere interaction; gas insulation of hot plasma; electric arcs between melting electrodes; spectroscopic investigation of rotating plasmas; accelerator development; and disruption of a low pressure mercury plasma. Also discussed is the development of the electron and plasma physics departments of the Institute. Author (ESRO)

N67-33645# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.

ELECTROSTATIC STABILITY OF PLASMAS OF FINITE LENGTH, IV [STABILITE ELECTROSTATIQUE DES PLASMAS DE LONGUEUR FINIE, IV]

M. Cotsaftis Aug. 1966 26 p In FRENCH
(EUR-CEA-FC-392)

In view of a coherent study of the finiteness effects along the magnetic field of an open-ended system, the very simple case of a double-stream system interacting inside a slab medium filled with a cold plasma is considered, limited by two infinite metallic plates perpendicular to the field lines. The particles of each stream, within the fluid approximation, are supposed to rebound on the two plates which are characterized by three coefficients R, S, μ. The method consisted in writing the general solution of the system of equations and verifying the boundary conditions one has posed on the two plates. NSA

N67-33717# Sandia Corp., Albuquerque, N. Mex.

CALCULATIONS FOR A LOW DENSITY PLASMA IMPEDANCE BRIDGE

Robert W. Harris Apr. 1967 28 p refs
(Contract AT(29-1)-789)
(SC-RR-67-190) CFSTI: HC $3.00/MF $0.65

An electrodeless null method for plasma impedance measurements is proposed. Calculations using the standard complex plasma conductivity expression indicate that the method should be sensitive to conductivities at least as low as 1 mho/meter at a bridge frequency of 1 Mc. The results indicate that at low densities ($\approx 10^{10}$ electrons cm^{-3}) the method is sensitive mostly to number density, although it may be possible to determine temperature also by a phase measurement technique. At higher densities ($\approx 10^{14}$ cm^{-3}) the method becomes insensitive to density and dependent mostly on temperature. Author (NSA)

N67-33737# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Plasmadynamik.

MEASUREMENTS WITH GASDYNAMIC PROBES IN A SUPERSONIC PLASMA JET [MESSUNGEN MIT GASDYNAMISCHEN SONDEN AN EINEM UEBERSCHALLPLASMASTRAHL]

Siegfried Krause Jul. 1966 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-66-49; DVL-546; NP-16718)

A certain number of independent measurements (depending on the degree of nonequilibrium of the plasma) with gasdynamic probes is required to determine unambiguously all thermodynamic properties and the speed of a flowing plasma. An example demonstrates how, by the aid of a working diagram, it is possible to derive graphically the unknown properties from the measured values. First measurements with gasdynamic probes of static pressure, local stagnation pressure, local mass flow, and local stagnation enthalpy of a supersonic plasma jet emerging from an electrothermal plasma accelerator are discussed, and show satisfying results. A new local stagnation enthalpy probe constructed for plasma jets with low local energy flow (e.g. for a heavily expanded supersonic plasma jet) is described. The experiments described are to be understood as a first step to explore diagnostically the modern electric thrustors with magnetic or self-magnetic acceleration. Author (NSA)

N67-33937# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMODYNAMIC AND GAS-DYNAMIC PARAMETERS OF LOW-TEMPERATURE PLASMA

T. V. Bashenova, S. G. Zaytsev, A. A. Kon'kov, Yu. V. Makanov, A. S. Pleshanov et al 21 Mar. 1967 12 p Transl. into ENGLISH of the Monograph "Termodinamicheskiye i Gazodinamicheskiye Parametry Nizkotemperaturnoy Plazmy" Moscow, 1965 p 1-12 Presented at the Intern. Congr. on Theoret. and Appl. Chem.
(FTD-MT-65-526; TT-67-62111; AD-653583) CFSTI: HC $3.00/MF $0.65

The report concerns results of calculations and experimental investigations of properties of low-temperature plasma on diaphragm

and electromagnetic shock tubes. A description is given of the methods of experiment. As a result of the work, tables are compiled of thermodynamic and gas-dynamic parameters of air, carbon dioxide, nitrogen, and alkali metals for temperatures of 1000-20,000K over a wide range of pressures. Certain experimental data are obtained on the nonequilibrium properties of plasma. TAB

N67-33950# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
PROPAGATION AND DIFFUSION OF A PLASMA COLUMN IN A MAGNETIC FIELD [PROPAGATION ET DIFFUSION D'UNE COLONNE DE PLASMA DANS UN CHAMP MAGNETIQUE]
Franco Bottiglioni, Jacques Coutant, Erio Gadda, and Francois Prevot Dec. 1966 38 p refs In FRENCH
(CEA-R-3130; EUR-3228.f)

A plasma column is created in a magnetic field by longitudinal diffusion from a low-pressure pulsed discharge in hydrogen. Depending on the discharge conditions, two regimes are obtained in which the gas pumping speed has a different effect upon the plasma density in the column. Calculations are presented which can explain this effect by a difference in the transverse diffusion coefficient. Author (NSA)

N67-33961# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
PARTIAL COROTATION OF A MAGNETIZED PLASMA
Hannes Alfven May 1967 17 p refs
(Rept.-67-08) CFSTI: HC $3.00/MF $0.65

If a magnetized celestial body rotates with the angular velocity Ω, it has a tendency to make a plasma in its surrounding share its rotation. Hydromagnetic effects work towards the establishment of isorotation, which means that all parts of the plasma rotate around the axis with an angular velocity ω which equals Ω. It seems plausible that very often the transfer of angular momentum is stopped long before $\omega = \Omega$ so that only a state of partial corotation is reached. The purpose of this paper is to study this state and especially the condensation of grains from it, a process which is of importance to the cosmogonic problem. The results are applied to the cosmogony of the Saturnian rings and the asteroid belt. ESRO

N67-33975# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DETECTION AND ANALYSIS OF NEUTRAL AND CHARGED PARTICLES. APPLICATION TO THE STUDY OF HOT PLASMAS [DETECTION ET ANALYSE DES PARTICULES CHARGEES ET NEUTRES APPLIQUEES A L'ETUDE DES PLASMAS CHAUDS]
Claude Renaud Dec. 1966 68 p refs In FRENCH
(CEA-R-3129; EUR-3225.f)

To measure the energy spectrum of ions in a plasma, the ions must be extracted without altering the spectrum. For a dense plasma this presents difficulties, and one method is the measurement of the energy spectrum of atoms produced by charge-exchange reactions of ions with residual gas. The measurements of both the energy spectrum and the flux of atoms leaving the magnetic configuration of the device DECA II (Dispositif d'Etude de Compression Adiabatique) are made by: an ion detector which permits the measurement of ion currents $\geq 10^{-18}$A, an electrostatic analyzer of energy range 10 eV to 10 keV, a magnetic analyzer for ion momentum $\leq 10^{5}$ gauss-cm, and a gas cell to convert fast atoms into ions. Author (NSA)

N67-33981# Mobil Oil Corp., Princeton, N. J. Research Dept.
[RESEARCH ON PLASMA PROBING WITH HIGH ENERGY BEAMS] Final Scientific Report, 1 Dec. 1965–30 Nov. 1966
R. L. Hickok, F. C. Jobes, J. F. Marshall, and S. L. Duncan Jan. 1967 56 p refs
(Contract AF 49(638)-1500)
(Rept.-2; AFOSR-67-0611; AD-647835) CFSTI: HC $3.00/MF $0.65

The report describes a technique for using the collisional dissociation of an energetic molecular ion beam to measure the relative density of a magnetically confined plasma with a three dimensional spatial resolution of 0.005 cc. The ultimate time resolution obtainable with this technique is of the order of 10 to the 7th power/(NI) where N is the density of charged particles per cc. Time resolution of the present measurements were limited to 10 to the 10th power/(NI) by the data collection system. (Author) 9 Author (TAB)

N67-33982# Mobil Oil Corp., Princeton, N. J. Research Dept.
PLASMA DENSITY MEASUREMENTS WITH ENERGETIC BEAMS
In its Res. on Plasma Probing with High Energy Beams Jan. 1967 39 p refs (See N67-33981 91-25)

Progress is reported in a program concerned with the development and application of diagnostic techniques to space and time resolved measurements of plasma densities. A technique is discussed for using the collisional dissociation of an energetic molecular ion beam to measure the relative density of a magnetically confined plasma with a three dimensional spatial resolution of 0.005 cm^3. The ultimate time resolution obtainable with this technique is of the order of 10^7/(NI) where N is the density of charged particles per cc. C.T.C.

N67-33983# Mobil Oil Corp., Princeton, N. J. Research Dept.
PLASMA DENSITY MEASUREMENTS BY MOLECULAR ION BREAKUP
R. L. Hickok *In its* Res. on Plasma Probing with High Energy Beams Jan. 1967 11 p refs (See N67-33981 19-25)

A method for using the collisional dissociation of an energetic molecular ion beam for measuring the relative density distribution of a magnetically confined plasma is described. A schematic diagram of the arc system is shown, and typical operating conditions are given. The advantages of this technique are: (1) it provides three dimensional spatial resolution, (2) does not require a differential pumping system, (3) can measure directly the intensity of the dissociated atomic ion rather than the attenuation of the primary beam, (4) can use electric and magnetic fields to direct the primary beam along selected paths and to rapidly and continuously change from one path to another, (5) does not disturb the plasma, (6) for beam energies such that the molecular ion velocity is much greater than the average velocity of the plasma electrons, the dissociation cross-section is independent of plasma temperatures, and (7) does not require an inversion calculation or any assumptions about the symmetry of the plasma. C.T.C.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-32703# Hewlett-Packard Co., Palo Alto, Calif.
INVESTIGATION AND DEVELOPMENT OF SEMICONDUCTOR-METAL CATHODES Scientific Interim Report
Lawrence S. Lerner, Robert J. Archer, and Thomas O. Yep Apr. 1967 60 p refs
(Contract AF 19(628)-5948)
(AFCRL-67-0296; SR-2; AD-653109) CFSTI: HC $3.00/MF $0.65

Research was undertaken in order to attain and measure the high degree of purity of specific monomers and to determine the effects of their high purity on the performance of the resultant polymer. Attempts were made to establish the ultimate performance that could be expected from selected polymers as well as the extent of effort required for purification of monomers beyond presently used procedures. The major portion of the research relates to poly(hexamethylenesdipamide), nlyon 66, and the effects of the high purity of adipic acid and hexamethylenediamine on various properties of the polyamide. Research was also initiated on the purification and measurement of purity monomers and solvents for polymerization to poly(ethylene methylene bis(4-phenylcarbamate)). Author (TAB)

N67-32723# Washington Univ., Seattle.
REFINEMENT OF THE CRYSTAL STRUCTURE OF GUANIDINIUM ALUMINUM SULFATE HEXAHYDRATE Final Report, 24 May 1963–31 Dec. 1966
B. J. B. Schein 31 Dec. 1966 143 p refs
(Grant DA-ARO(D)-31-124-G459)
(AROD-4365-2-C; AD-652695) CFSTI: HC $3.00/MF $0.65

Descriptions are given of x-ray diffraction investigations (using three-dimensional MoKa data) of the crystal structure of the ferroelectric substances, guanidinium aluminum sulfate hexahydrate, and its chromium isomorph. Full-matrix least-squares refinement of the structure resulted in final R values of 0.035 and 0.036, respectively. Author (TAB)

N67-32738# New York Univ., N. Y.
GENERATION OF CHARGE CARRIERS IN ANTHRACENE WITH POLARIZED LIGHT
Nicholas Geacintov and Martin Pope [1967] 8 p refs
(Contract Nonr-285(41))
(AD-652403) CFSTI: HC $3.00/MF $0.65

In order to ascertain the dependence of bulk generated photocurrent on the absorption coefficient in anthracene, a study was made of the relative quantum efficiency of the photocurrent at fixed wavelength as a function of the angle, Theta, between the electric vector of polarized light and the b crystalline axis. TAB

N67-32746*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
CONDUCTIVITY PHENOMENA IN POLYCRYSTALLINE ZINC OXIDE FILMS
M. L. McDaniel, R. R. Mitchell, and H. J. Watson Jun. 1967 30 p refs
(Contract NAS8-20166)
(NASA-CR-87157; R-237) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Conductivity in thin zinc oxide films is found to increase as film thickness increases. An empirical relation expressing this phenomena is given along with a physical explanation. Time rate change of conductivity data and voluntary response due to incremental changes in pressure are briefly discussed. Author

N67-32748# New York Univ., N. Y. Physics Dept.
DELAYED HOLE DISCHARGE AT TETRACENE CRYSTAL-AQUEOUS ELECTRODE INTERFACES
Nicholas Geacintov, Martin Pope, and Hartmut Kallmann [1967] 7 p refs
(Contract Nonr-285(41))
(AD-652402) CFSTI: HC $3.00/MF $0.65

A delayed neutralization of photoinjected holes at anthracene-aqueous electrode interfaces has been previously noted. The same effect also occurs in tetracene crystals with aqueous electrodes. The delayed discharge is much more pronounced and can be observed at frequencies as low as 0.01 cps. Up to 0.0000001 coul/sq.cm of charge can be stored at (or very near) the negative, dark electrode. It appears that holes are accumulated in shallow surface states. These surface states appear to be related to surface defects or impurities since there is such a large variation with different crystals. Furthermore, the hole storage is associated with the presence of oxygen. Preliminary experiments show that the amount of charge, Q, can be decreased by 75% if the crystal surface and H2O electrode are subjected even to a crude degassing procedure. Re-exposing the surface to air and using ordinary distilled water restores the previous value of Q. The holes probably form a weak dipole layer with the negative ions in the solution. TAB

N67-32752# Israel Atomic Energy Commission, Beersheba. Soreq Nuclear Research Center.
OPTICAL AND ELECTRICAL PROPERTIES OF DIAMOND Final Report, 1 Nov. 1963–31 Oct. 1966
A. Halperin, V. Bar, R. Chen, and J. Levinson Feb. 1967 183 p refs
(Contract AF 61(052)-759)
(AFCRL-67-0322; AD-653201) CFSTI: HC $3.00/MF $0.65

Results of an investigation of some of the optical and electrical properties of diamond are described. The work included both semiconducting and insulating diamonds. After the Introduction in Chapter 1, the background for thermoluminescence (TL) work, including the development of some theoretical aspects of the correlation between TL and thermally stimulated currents (TSC) is presented in Chapter 2. The next chapter (Chapter 3) deals with the TL of semiconducting diamonds, including the observation of blue and red emitting glow peaks, and their characteristics. Chapter 4 deals with the decay of the phosphorescence at 77K in UV excited semiconducting and insulating diamonds. Chapter 5 deals with the photovoltaic effect in semiconducting and insulating diamonds and its dependence on wavelength. Chapter 6 deals with the electroluminescence (EL) of semiconducting diamonds. Lastly, Chapter 7 discusses electrically excited thermoluminescence in semiconducting diamonds. TAB

N67-32772# New York Univ., N. Y. Physics Dept.
MECHANISMS OF ENERGY TRANSFER IN DIELECTRICS Semiannual Report, 1 Feb.–31 Aug. 1966
Hartmut P. Kallmann and Werner Brandt May 1967 30 p
(Contract DA-28-043-AMC-01999(E))
(Rept.-1; ECOM-01999-1; AD-652723) CFSTI: HC $3.00/MF $0.65

Experimental and theoretical studies of the influence of X-rays on the electric behavior of dielectric materials have been undertaken. Their ultimate goal is to determine the number of free charges produced by a given amount of energy absorbed in various dielectric materials, the external field strength necessary to collect all the charges made available by X-rays, and the number of trapping sites for positive and negative charges produced by X-rays. Experiments with anthracene and polystyrene are described. A subnanosecond coincidence apparatus for the investigation of positron annihilation spectra in materials has been assembled, tested and calibrated. Target chambers of various designs for studying the influence of high electric fields on these spectra are being constructed and tested. Our computer program for data analysis has been rewritten for the CDC 6800 computer of New York University Computer Center. The theory for the electric field effect is being formulated. Complementary work on the study of defects in insulators by positron annihilations is described. Author (TAB)

N67-32776# Norwegian Inst. of Tech., Trondheim. Electrical Engineering Dept.
WAVE PROPAGATION IN SEMICONDUCTORS WITH DRIFTING CARRIERS
Reidar Kuvas Mar. 1967 76 p refs
(Contract AF 61(052)-907)
(Rept.-3; SR-2; RADC-TR-67-336; AD-653202) CFSTI: HC $3.00/MF $0.65

A macroscopic theory for propagation of plane RF waves in semiconductors is presented. The first part deals with an extrinsic semiconductor where the elementary modes and their dispersion relations are derived from the wave equation. General boundary conditions for a semi-infinite semiconductor bounding to vacuum are considered, and six possible modes of wave propagation are found. A general expression for the power density of a plane wave is derived and used to establish a criterion for active behaviour of the medium. Instability phenomena and their relation to possible amplifying and oscillating behaviour of the medium are considered. In the last part the analysis is extended to semiconductors having two types of carriers. The dispersion relations are derived. In particular, propagation of carrier waves in an electron-hole plasma and a two-valley semiconductor is considered. Author (TAB)

N67-32778# Pennsylvania Univ., Philadelphia. Dept. of Physics.
ACOUSTICAL ACTIVITY AND RELATED PHENOMENA IN CRYSTALS
David Lawrence Portigal (Ph.D. Thesis) May 1967 201 p refs
(Contract Nonr-551(51))
(TR-12; AD-652935) CFSTI: HC $3.00/MF $0.65

Rotatory polarization of transverse acoustic waves is considered. It is demonstrated phenomenologically that, due to spatial dispersion, such acoustical activity should be observable in optically active crystal classes, its magnitude being obtainable from phonon dispersion curves. An estimate of the acoustical activity of tellurium is so obtained. An attempt to measure the acoustical activity of tellurium is described. Alignment requirements are shown to be too critical to detect activity in such trigonal crystals. The effect of conical refraction on the observation of acoustical activity is considered. A similar formalism is applied to an improved study of optical internal conical refraction. Author (TAB)

N67-32794# Airtron, Inc., Morris Plains, N. J.
HYDROTHERMAL GROWTH OF CRYSTALS OF $LaAlO_3$ Final Report, 14 Aug. 1964–14 Aug. 1966
Aug. 1966 58 p refs
(Contract Nonr-4616(00); ARPA Order 306-62; Proj. Defender)
(RII-530; AD-652375) CFSTI: HC $3.00/MF $0.65

Two new molten salt solvent systems were found from which LaAlO3 could be crystallized, PbF2-B2O3 and Bi2O3 - B2O3. The conditions and compositions for using these solvents were developed so that crystals one half to one inch on edge were grown. In the PbF2-B2O3 system the most successful growth was accomplished by operating in the 1500-1200C temperature range. In the case of the Bi2O3-B2O3 system there is an acceleration of the grain growth of the platinum, which leads to premature failure of the crucibles. The crystallization paths for LaAlO3 growth were studied for melts containing stoichiometric quantities of La2O3 and Al2O3 and also Al2O3 rich melts. The initial work in small reactors in the hydrothermal system appeared most encouraging. Almost immediately a suitable solvent, K2CO3, was found and after experimentation with the system variables, growth on seeds was obtained below a crystallization temperature of 425C. In these runs flux grown LaAlO3 crystals were used for seeds and nutrient. In large autoclaves only limited success was achieved with crystal growth in both two and three zone systems. TAB

N67-32892# New York Univ., N. Y. Dept. of Chemistry.
AUTOIONIZATION IN ANTHRACENE
Martin Pope [1967] 7 p refs
(AD-652401) CFSTI: HC $3.00/MF $0.65

A comparison is made of the external photoelectric effect produced by a single photon process, with that produced by an exciton-exciton process. The results are consistent with the conclusion that at least for excitation energies up to 6.3 eV, the internal intrinsic carrier generation mechanism is that of autoionization for both processes. Author (TAB)

N67-32963# California Univ., Berkeley. Lawrence Radiation Lab.
DEMONSTRATION OF FLUX QUANTIZATION AND THE JOSEPHSON EFFECT IN SUPERCONDUCTORS
C. C. Grimes, S. Shapiro (Bell Telephone Labs., Inc., Murray Hill, N. J.), and P. L. Richards Jan. 1967 9 p refs Presented at the Ann. Meeting of the Am. Phys. Soc., New York
(Contract W-7405-ENG-48)
(UCRL-17380; CONF-670109-9) CFSTI: HC $3.00/MF $0.65

Two recent developments in the study of superconductivity, flux quantization and the Josephson effect, are demonstrated with relatively simple apparatus. These experiments are intended to complement the discussion in Feynman's Lectures on Physics, Vol. III. Author (NSA)

N67-32996*# Delaware Univ., Newark. Dept. of Physics.
PRODUCTION AND ANNEALING OF INTRINSIC DEFECTS IN X-RAY IRRADIATED CdS SINGLE CRYSTALS
K. W. Boer, and J. C. O'Connell May 1967 15 p
(Grant NsG-573; Contract Nonr-4336(00))
(NASA-CR-87330; TR-18; TR-13; AD-652611) CFSTI: HC $3.00/MF $0.65 CSCL 20L

X-rays (300 keV) have been used to produce changes in the defect structure of (1) pure single-crystal platelets of CdS and (2) platelets which have been pre-heat treated in the vapor of one of its components. The changes were studied by means of the spectral distribution of photocurrent and T.S.C. curves. All measurements were made in ultrahigh vacuum (10 to the -10th power Torr). The damage produced annealed at temperatures between 100 and 150C. The reproducible damage-annealing cycle has been explained in terms of intrinsic defects produced in the sulfur sublattice. Damage-annealing cycles for crystals pre-heat treated in Cd or S vapor (stoichiometry shift) provide additional confirmation for the proposed model. Author (TAB)

N67-33002# California Univ., Livermore. Lawrence Radiation Lab.
OBSERVATION OF CRYSTAL FIELDS BY MEANS OF THE MOESSBAUER EFFECT
Richard J. Borg 18 Jan. 1967 35 p refs Presented at the Am. Soc. for Metals, Natl. Metal Exposition, and Congr., Chicago, Oct. 1966
(Contract W-7405-ENG-48)
(UCRL-14929; CONF-661031-3) CFSTI: HC $3.00/MF $0.65

Data obtained from Au–Fe solid solutions are used to illustrate the Moessbauer technique for study of structure of metals and metallic solutions. Moessbauer spectra for six alloy compositions are shown and interpreted in terms of the nature and distribution of the atoms. The determination of the electric field gradient from Moessbauer measurements is discussed. NSA

N67-33056# Massachusetts Inst. of Tech., Cambridge.
SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report

15 Apr. 1967 58 p refs
(Contracts Nonr-1841(34); AF 19(628)-356; Grants NSF G-10821; NSF G-24908; NSF GP-3241)
(QPR-64; AD-651911)

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N67-33059# Massachusetts Inst. of Tech., Cambridge.
ELECTRONIC STATES OF MAGNETIC IMPURITIES IN NONMAGNETIC METALS
J. Sokoloff *In its* Solid-State and Mol. Theory Group 15 Apr. 1967 p 1–24 refs (See N67-33058 19-26)

Consideration is given to the problem of determining the electronic structure of dilute substitutional alloys of iron series impurities in copper. The model takes into consideration the actual band structure of copper, and the impurity is assumed to be a bound state coming directly out of the 3d bands of copper and mixing with the conduction bands to give it a level width. The basis of the solution consists of 3d atomic orbitals and orthogonalized plane waves which are generated by an interpolation scheme. The problem is solved in the Hartree–Fock approximation, using a Green function formalism to obtain self-consistency in a limited sense. Using this formalism, calculations are made of the charge density and magnetic moments near the impurity site. C.T.C.

N67-33060# Massachusetts Inst. of Tech., Cambridge.
IMPURITY SCREENING IN AN INHOMOGENEOUS ELECTRON GAS. I: GENERAL FORMALISM; SIMPLE RPA SCREENING
J. W. Gadzuk *In its* Solid-State and Mol. Theory Group 15 Apr. 1967 p 25–36 refs (See N67-33058 19-26)

Consideration is given to a problem dealing with the fact that in the electron gas theories, the implicit assumption of complete spatial homogeneity is always true. Methods are developed for considering the essential inhomogeneous nature of electron gases in real metals by assuming a point impurity polarizing an electron gas. A Green function formalism is developed, and used in treating inhomogeneity corrections in Thomas–Fermi atoms. Considerable effort is devoted to a general formal development of the theory of an impurity in an originally uniform gas, and specific calculations are made to obtain an expression for the induced charge density as a function of position from the impurity or ion core. C.T.C.

N67-33061# Massachusetts Inst. of Tech., Cambridge.
A CRYSTAL POTENTIAL FOR GREY TIN
D. Koelling *In its* Solid-State and Mol. Theory Group 15 Apr. 1967 p 37–42 refs (See N67-33058 19-26)

An APW calculation is set up by starting with a potential which is the superposition of free atom potentials centered at each lattice site and adding to it the Slater exchange approximation using the superposed charge densities. This yields an equation in atomic units, and is approximated by a muffin-tin potential. C.T.C.

N67-33097# Iowa State Univ. of Science and Technology, Ames.
HALL EFFECT OF GADOLINIUM, LUTETIUM, AND YTTRIUM SINGLE CRYSTALS
Ronald Stanley Lee (Ph.D. Thesis) Feb. 1967 80 p refs
(Contract W-7405-ENG-82)
(IS-T-139) CFSTI: HC $3.00/MF $0.65

The Hall effect of gadolinium single crystals was measured in the temperature range 4.2 to 340°K in magnetic fields up to 30 kOe. The Hall effect of lutetium and yttrium single crystals was measured in the temperature range 8 to 320°K in magnetic fields up to 7.8 kOe. For the lutetium and yttrium single crystals the Hall coefficient was measured using an ac technique with the magnetic field applied along the c axis and in the basal plane. A large anisotropy and strong temperature dependence of the Hall coefficient was observed in both of these metals. The temperature dependence is interpreted in terms of the transition from impurity scattering at low temperatures to scattering from phonons at high temperatures. The anisotropy of the Hall coefficient observed in these crystals is interpreted in terms of the anisotropy of the Fermi surface. A dc method was used to measure the Hall effect of the gadolinium crystals. The magnetic field was applied in the a, b, and c directions. R_0, the ordinary Hall coefficient, and R_1, the extraordinary Hall coefficient, were determined as a function of temperature. R_0 is interpreted in terms of changes in the Fermi surface induced by exchange splitting of the conduction bands. R_1 has a ρ^2 temperature dependence below 160°K, where ρ is the electrical resistivity. The deviation from ρ^2 dependence is interpreted as being due to changes in the Fermi surface with temperature. Author (NSA)

N67-33161# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE STUDY OF SCREW DISLOCATIONS [CONTRIBUTION A L'ETUDE DES DISLOCATIONS HELICODALES]
Jean Grilhe (Ph.D. Thesis—Paris Univ., Orsay, France) 1966 65 p refs In FRENCH; ENGLISH summary
(CEA-R-2916) CFSTI: HC $3.00/MF $0.65

The germination, growth, and properties of screw dislocations are studied. The main experimental results obtained by various authors (observations of screws in ionic crystals, in silicon crystals, and in aluminum based alloys) are briefly described. A few considerations concerning characteristic screw geometry and the various methods used for calculating the energy of dislocation, are made. Problems involving only slip of the screw around its cylinder are studied. The equilibrium step as a function of the forces acting on the extremities, is calculated. The critical stress required to disrupt the screw and to study the interactions between the screw and other dislocations of the lattice, is determined. The problem of the stability when the dislocation can climb by absorption or emission of vacancies is considered, and a germination model for the screw is put forward. Results were used to study the growth of the spirals formed in the model. L.S.

N67-33213# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
SILICON P-I-N JUNCTIONS USED FOR STUDIES OF RADIATION DAMAGE [ETUDE DE L'IRRADIATION AUX NEUTRONS RAPIDES DU SILICIUM AU MOYEN DE JONCTIONS PIN]
Jean-Claude Lanore (Ph.D. Thesis—Paris Univ.) 1966 104 p refs In FRENCH; ENGLISH summary
(CEA-R-3061)

Irradiation of a silicon P.I.N. junction was studied for the purpose of developing a radiation damage dosimeter, and for investigating silicon itself. It is known that the rate of recombination of electrons and holes is a linear function of defects introduced by neutron irradiation. Two methods were used to measure that rate of recombination: (1) forward characteristic measurements, and

(2) recovery time measurements. In order to explain how these two parameters depend on recombination rate we give a theory of the P.I.N. junction. We also give an idea of the carrier lifetime dependance versus temperature. Annealing effects in the range of 70 to 700°K have also been studied. Five annealing stages with corresponding activation energies were found. As an application for these studies, we developed a radiation damage dosimeter with which we made several experiments in facilities such as Naïade or Marius. Author

N67-33283# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

CONTRIBUTION TO THE STUDY, BY MAGNETIC RESONANCE, OF THE PROPERTIES OF HEAVILY DOPED SILICON AT LOW TEMPERATURE [CONTRIBUTION A L'ETUDE PAR RESONANCE MAGNETIQUE DES PROPRIETES A BASSE TEMPERATURE DU SILICIUM FORTEMENT DOPE]

Denis Jerome (Ph.D. Thesis—Paris Univ., Orsay, France) 1966 80 p refs In FRENCH; ENGLISH summary
(CEA-R-2893)

The magnetic properties of heavily doped silicon at low temperature have been studied in a range of concentration on either side of the Mott transition. For impurity densities less than that of the transition a magnetic double resonance method allows the exchange coupling between localized donors to be measured, and in addition the existence of paramagnetic centers (pairs of neutral and ionized donors) is demonstrated. The behavior of the spin-lattice relaxation of ^{29}Si is explained in terms of the dipolar coupling between nuclei and paramagnetic centers. In the range of concentration 10^{16}–10^{17} impurities/cm^3, the concentration dependent relaxation of donors is studied experimentally. A theoretical explanation is proposed for the latter mechanism, the basis of which is the presence of ionized pairs of donors. At increasing impurity concentrations the electronic delocalization increases. Author

N67-33285# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

DIFFUSION ALONG AND AROUND DISLOCATIONS [DIFFUSION LE LONG ET AUTOUR DES DISLOCATIONS]

Gilbert Brebec Oct. 1965 18 p refs In FRENCH; ENGLISH summary
(CEA-R-2831) CFSTI: HC $3.00/MF $0.65

Some solutions for Fick's equations applicable to diffusion in dislocations are given. The problem is fairly similar to that of grain boundaries but in this case a further difficulty arises, (purely mathematical in fact), due to the supposedly cylindrical shape of the perturbed region around a dislocation. Fick's equation is used in a given form in order to express simply the limiting conditions so that the solution takes into account the symmetry of revolution of the system. This complicates the final form of the results. A solution obtained using the same hypotheses and making the same approximations as those employed by Whipple for his grain boundary work, is given as an illustration. Author

N67-33344# IIT Research Inst., Chicago, Ill. Dept. of Physics.

INVESTIGATION OF ENERGY TRANSFER PROCESSES BY FLASH PHOTOLYSIS (RADIATION EFFECTS IN SOLIDS) Progress Report, Feb. 1966–Feb. 1967

Leonard I. Grossweiner Feb. 1967 30 p refs
(Contract AT(11-1)-1052)
(COO-1052-7; PR-9) CFSTI: HC $3.00/MF $0.65

Work done on projects relating to radiation effects on mechanical, electrical, and optical properties of ionic solids is summarized. Optical pumping and decay of the M center triplet state and R center quartet state in irradiated KCl were investigated with pulsed-light methods. The conversion of F centers to M centers in additively colored and Co^{60}-irradiated KCl induced by repetitive 1-μsec pulses of F light was measured as a function of repetition rate, temperature, and initial F-center density. Growth of higher F-aggregate centers in KCl was investigated by controlled optical bleaching at elevated temperatures, with emphasis on the N and T centers whose structures have not been identified. The changes in the fracture surface energy of KCl induced by Co^{60} and X-irradiation were correlated with the F-center density. A new theory of dye-sensitized electrical conductivity in ZnO films is presented, based on experimental results showing that sensitization is actually a light-induced return of electrons that migrate in the dark from ZnO to the dye. NSA

N67-33361# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

THERMAL PROPERTIES OF GOLD–SILICON BINARY ALLOY NEAR THE EUTECTIC COMPOSITION

H. S. Chen and D. Turnbull May 1967 24 p refs
(Contracts Nonr-1866(50); ARPA SD-88)
(TR-522; AD-654167) CFSTI: HC $3.00/MF $0.65

We have measured the specific heat, CP, and the enthalpy of Au-18.6 at % Si alloy in some of its various forms. CP of the liquid form falls continuously with increasing temperature from 8.38 plus or minus 0.05 at 563K, corresponding to an undercooling of 73K, to 7.90 plus or minus 0.05 cal/gfw-K and it exhibits no singular behavior at the melting temperature, Tm. It exceeds the heat capacity of the eutectic solid by 1.87 cal/gfwK at Tm. This high specific heat in the liquid state and its decrease with increasing temperature is attributed principally to the configurational entropy as has been suggested for the pure liquid metals. CP of the amorphous alloy, formed by rapidly chilling the liquid, was measured for the temperature range from 208 to 278K. It rises slowly to 225K, then falls, and then rises again with increasing temperature. It exceeds CP of the eutectic solid by 0.2 to 0.4 cal/gfw-K. CP of the metastable intermetallic crystalline phase, formed when the liquid is less rapidly chilled, falls between the values for the eutectic and amorphous solids. The especially deep lying eutectic exhibited by this system is attributed to the tendency for unlike atoms to associate when in the metallic state, in contrast with the strong tendency for phase separation in the solid state owing to the high stability of silicon in its covalent crystalline form.
Author (TAB)

N67-33390*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

RESONANCE AND WAVE PHENOMENA IN SEMICONDUCTORS

T. O. Poehler *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Work has continued on the excitation of instabilities and microwave emission from high purity n-type indium antimonide. The study of the emission spectrum of n-type InSb mounted as inductive posts in waveguide was extended to over 100 Gc/s. This emission spectrum did not decrease at high frequencies as sharply as reported by other authors. The emission spectrum has also been studied, using specimens mounted axially in cylindrical waveguide in both transverse and longitudinal magnetic fields. The radiation spectrum observed is similar to that for the specimen mounted as inductive posts. The emission from the axial configuration in a longitudinal magnetic field was unique because part of the radiation occurred after the electric field pulse had concluded. Author

N67-33392# Brown Univ., Providence, R. I. Div. of Engineering.

HERTZIAN FRACTURE IN SINGLE CRYSTALS WITH THE DIAMOND STRUCTURE

Brian R. Lawn May 1967 29 p refs
(Contracts ARPA E-40; ARPA SD-86)
(AD-653857) CFSTI: HC $3.00/MF $0.65

Extension of an earlier theory of Hertzian fracture in brittle isotropic materials is made to include the case of brittle single crystals. A criterion is first proposed for predicting the path of a crack through an inhomogeneously stressed crystal in terms of the surface energy anisotropy of the crystal and the stresses prior to fracture occurring. This criterion is then applied to determine the geometry of cracks formed in the Hertzian stress field in crystals having the diamond structure. The computed crack geometries agree well with observation. An analysis of the fracture mechanics of crack growth into the crystal subsequently indicates that for a certain range of indenter size the Hertzian crack passes through four equilibrium stages, as it does in glass, before reaching its fully developed length. As a result Auerbachs law holds, i.e. the critical load on the indenter necessary to produce a fully developed Hertzian fracture is proportional to the radius of the indenter. This law is confirmed by Hertzian fracture tests on silicon single crystals. Finally, possible application of the Hertzian test to the study of some mechanical properties, such as fatigue, of brittle single crystals is indicated. Author (TAB)

N67-33415# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GALLIUM ARSENIDE SEMICONDUCTOR MATERIALS

Chao Chen-sze 25 Jan. 1967 9 p Transl. into ENGLISH from Wuhsien Tien, no. 6, 1965 p 3–15

(FTD-HT-66-580; AD-653506) CFSTI: HC $3.00/MF $0.65

The document is based on a translation of a foreign (non-Chinese) paper, the origin of which is not mentioned. Desirable features of gallium arsenide include high electron migration rate, high operating temperature, high operating voltage, and high radiation resistance. Gallium arsenide elements are capable of operating at +300° to −180°C. Possession of a high radiation-resistant property enables the use of gallium arsenide elements in artificial satellites and space vehicles. Gallium arsenide reactance tubes have a cutoff frequency beyond 800 kmc, and gallium arsenide switch tubes have a switching speed lower than 10 to the −9th power sec. A gallium arsenide laser having a luminous efficiency of 60% and a high output power has been developed. The laser can be used for short-distance communications, microwave modulation, and electronic computer control. Author (TAB)

N67-33428# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

ELECTRONIC SPECIFIC HEATS AT LOW TEMPERATURE OF TANTALUM HYDROGEN COMPOUNDS [CHALEURS SPECIFIQUES ELECTRONIQUES A BASSE TEMPERATURE DES COMPOSES TANTALE–HYDROGENE]

Francois Ducastelle, Paul Costa, Rene Caudron, and Bernard Saulgeot 1967 18 p refs In FRENCH; ENGLISH summary Presented at the 2d Intern. Colloq. on Solid Compds. of Transition Elem., Groningen, Netherlands, 12–16 Jun. 1967

(ONERA-TP-479(1967)) CFSTI: HC $3.00/MF $0.65

Specific heat measurements in the 3° to 9°K range were carried out on TaH_x specimens having H/Ta ratios of 0, 0.06, 0.16, 0.25, and 0.58. Corresponding values of γ (the electronic specific heat coefficient) are 5.28, 4.93, 4.64, 3.31, and 2.42 mJ/deg^2 per g-atom of tantalum. Values of the Debye temperature are 241°, 244°, 252°, 259°, and 273°K. The values of γ are in good agreement with a rigid band model for the d band of the metal, the electron of the hydrogen filling this d band. The $TaH_{0.06}$–$TaH_{0.16}$ and $TaH_{0.25}$ specimens are super conductors, but the transition temperature is spread over a broad zone with an upper value of 4.40°K (the critical temperature for tantalum). This result could be the consequence of low temperature phase transformations on these specimens. The $TaH_{0.58}$ specimen is not a superconductor above 1.6°K. Author (ESRO)

N67-33430# General Electric Co., Schenectady, N. Y. Research and Development Center, K-1.

MECHANISM OF CHARGE TRANSPORT AND LIGHT EMISSION IN $ZnSe_xTe_{1-x}$ p–n JUNCTIONS

M. Aven and W. Garwacki *In its* New Solid-State Device Concepts Dec. 1966 p 1–26 refs (See N67-33429 19-09)

Analyzed are general diode characteristics of the $ZnSe_xTe_{1-x}$ p–n junctions; electrical transport properties in bulk n- and p-type crystals and operating diodes; and photoconductive characteristics and the luminescent response of high resistivity $ZnSe_xTe_{1-x}$ crystals. It is shown that junction diodes prepared from $ZnSe_xTe_{1-x}$ pass very little current and emit no light after being cooled in the dark to 80°K. A momentary illumination with radiation of $h\nu > 1.9$ eV will initiate a steady efficient light emission, and produce an increase in current by a factor of 10^{10}. A mechanism based upon self induced photoconductivity is proposed to account for this behavior. S.C.W.

N67-33431# General Electric Co., Schenectady, N. Y. Research and Development Center, K-1.

DIFFUSION OF THE CHALCOGENS IN THE II–VI COMPOUNDS

H. H. Woodbury and R. B. Hall *In its* New Solid-State Device Concepts Dec. 1966 p 27–64 refs (See N67-33429 19-09)

A consistent model to explain the chalcogen self diffusion data in the II–VI compounds has been demonstrated which involves the existence of an appreciable concentration of fast diffusing, neutral, atomic interstitial chalcogen defects over most of the solidus region. Under maximum metal pressure firing conditions, a chalcogen vacancy mechanism may be operative. It is suggested that the chemical equilibrium and deviations from stoichiometry are dominated by the proposed neutral interstitials. It is further proposed that the only electrically active native defects are vacancies and that their concentrations are often determined by interactions with impurities to form complexes or by the position of the Fermi level, as well as with the component partial pressures over the compound. Author

N67-33447# Emmanuel Coll., Boston, Mass. Oriental Science Library.

THE RESONANCE FREQUENCY OF AN ANISOTROPIC FERROMAGNET

Suen Shin Bedford, Mass., AFCRL, Apr. 1967 19 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 10, 1965 p 1776–1784

(Contract AF 19(628)-5073)

(EMM-66-126; AD-653969) CFSTI: HC $3.00/MF $0.65

The magnetization and resonance frequency of an anisotropic ferromagnet are calculated by the method of rotation of the coordinate system. The relation between the resonance frequency and the exchange interaction tensor is derived, from which and from the resonance data obtained experimentally the direction of the principal axes and the principal values of the exchange interaction may be determined. Author (TAB)

N67-33486# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.

EXISTENCE AND STRUCTURE OF RARE-EARTH MONOCARBIDES: STUDY OF THEIR LOW-TEMPERATURE MAGNETIC PROPERTIES [EXISTENCE ET STRUCTURE DES MONOCARBURES DE TERRES RARES. ETUDE DE LEURS PROPRIETES MAGNETIQUES A BASSES TEMPERATURES]

Robert Lallement (Ph.D. Thesis—Paris Univ., Orsay) 1966 67 p refs In FRENCH

(CEA-R-3043)

There are two types of rare earth carbides, the first one is fcc, stable at high temperature, and very hypostoichiometric

(formula MC_x with $0.35 < x < 0.65$); the other is rhombohedric, stable at lower temperature, with a formula M_2C. These two carbides are magnetically ordered at low temperatures (ferro or ferri-magnetism). They are highly anisotropic. A great part of the electric and magnetic properties can be explained from the following ideas: the M^{3+} ions are coupled via the conduction electrons, there are more conduction electrons in the carbides than in the metals, and there is some local order around the transition temperatures. Author (NSA)

N67-33589* Case Inst. of Tech., Cleveland, Ohio.
IMPURITIES AND INTERFACE STATES IN THE SiO_2/Si SYSTEM Semi-Final Report
1 Jul. 1967 17 p refs
(Grant NGR-36-003-067)
(NASA-CR-87288) CFSTI: HC$3.00/MF$0.65 CSCL 20L

Results presented include: (1) P_2O_5 glassing not only getters Na, but also stabilizes SiO_2 even at concentrations of Na around 10^{18} cm^{-3}. (2) A model for instability of Si surface potential has been developed which explains slow drift with field-plate positive followed by fast drift with plate negative in hot-bias MOS tests. Preliminary results of hydration and radioactive gold experiments are also reported. Author

N67-33679# Commissarait a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SOME RESULTS CONCERNING THE EXTERNAL PHOTOELECTRIC EFFECT AND SECONDARY EMISSION [QUELQUES RESULTATS SUR L'EFFET PHOTOELECTRIQUE EXTERNE ET L'EMISSION SECONDAIRE]
Francois Lenouvel Jan. 1967 74 p refs In FRENCH
(CEA-R-3143)

The characteristics and limiting possibilities of the various constituent parts of a photoelectric detector are considered. Two methods for illuminating the cathode are described and discussed. The few scattered results concerning the maximum output of cathodes and dynodes are collected together and a tentative explanation is put forward. A comparison is made of three methods for measuring very low light fluxes. Author (NSA)

N67-33716# Oak Ridge National Lab., Tenn.
SOLID STATE DIVISION Annual Progress Report, Period Ending 31 Dec. 1966
Mar. 1967 110 p refs
(Contract W-7405-ENG-26)
(ORNL-4098) CFSTI: HC$3.00/MF$0.65

Brief summaries of work on 122 projects are presented. Many of the summaries are abstracts of papers published, to be published, or submitted for publication. A list of published papers is included. NSA

N67-33891# Commissariat a l'Energie Atomique, Grenoble (France).
OSCILLATION PRODUCTION IN SEMICONDUCTING MEDIA [GENERATION D'OSCILLATIONS DANS LES MILIEUX SEMICONDUCTEURS]
Bernard Prunieux Feb. 1967 23 p refs In FRENCH
(CEA-BIB-77)

The production of microwave oscillations by the application of a strong electric field to a crystal semiconductor (Gunn effect) is studied from the phenomenological and theoretical points of view. Devices based on this principle, in the form of oscillators or amplifiers in the billion cycles/second range, have been built. The performances obtained appear to be very promising. Author (NSA)

N67-33897# Illinois Univ., Urbana. Materials Research Lab.
MATERIALS SCIENCES RESEARCH Annual Technical Report, 1965–1966
1 Nov. 1966 157 p refs
(Contract ARPA SD-131)
(AD-650265) CFSTI: HC$3.00/MF$0.65

Brief summaries are given of the status and results of ARPA and AEC supported research programs at the U of I materials research labs in the areas of cryogenics, crystallography, spectroscopy, metal physics, superconductivity, semiconductors, solid state physics and electronics, phase studies, high-pressure research, radiation damage, and related topics. A complete listing of published papers and theses is included. TAB

N67-33925# Franklin Inst., Philadelphia, Pa. Research Labs.
RESEARCH ON STRIPE DOMAIN STRUCTURES IN FERROMAGNETIC METAL FILMS Final Report, 15 Dec. 1965–15 Dec. 1966
J. D. Blades and J. B. Drew 14 Jan. 1967 49 p refs
(Contract AF 19(628)-5808)
(F-B2462; AFCRL-67-0219; AD-653601) CFSTI: HC $3.00/MF $0.65

An experimental and theoretical investigation of ferromagnetic thin films, demonstrating anaomalous stripe domains, has been conducted. The origin of the stripe domains is attributed to the existence of a uniaxial anisotropy perpendicular to the plane of the film which develops from a planar stress system and a vapor beam angle of incidence pile-up structure both relatable to fabrication procedures. The stripe domain configuration is a planar 180 degree alternating direction of magnetization pattern with 180 degree Bloch transition walls. It is shown that the existence of a spin-wave type stripe domain system requires (1) a perpendicular anisotropy larger than the planar shape anisotropy or (2) an effective planar demagnetizing field through small sample size in addition to a perpendicular anistropy less than the planar shape anisotropy. Author (TAB)

N67-33953# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
EFFECT OF NUCLEAR RADIATION ON OXIDIZED SILICON SURFACES
Jerry A. Hood Dec. 1966 130 p refs Prepared for Sandia Corp., N. Mex.
(Contract AT(29-1)-789)
(SC-CR-67-2571; EE-139) CFSTI: HC$3.00/MF$0.65

The SiO_2 is modeled using energy band characteristics. The total energy deposited in the oxide due to the radiation flux is converted to free-electron and trapped-hole pairs. The transport and recombination of the electrons result in a positive charge in the oxide. This distribution of these positive charges depends on properties of the oxide, the energy absorbed from the radiation, and the bias voltage across the oxide at the time of irradiation, and is used to calculate the change in the relation between the bias voltage across the oxide and the charge induced in the silicon surface. The positive charges in the oxide are stable for many months and temperatures well in excess of 200°C are required for annealing in any reasonable time. The radiation damage at the interface could not be resolved uniquely. The introduction of energy states at the interface could not be distinguished from a decrease in free carrier mobility at the surface because of measurement errors. By assuming that the surface mobility was constant and not affected by the nuclear radiation, the introduction of interface energy states is characterized. It was also assumed that no interface energy states were introduced and the change in surface mobility caused by the nuclear radiation is characterized. Since the true effect is not known at this time, either a constant mobility or zero interface states can be assumed and the behavior of the devices described. This gives a model to the observed radiation-induced

change in electrical parameters of these types of devices. By applying the model, device types and design changes can be compared for radiation tolerance. Author (NSA)

N67-33967# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneaux.
ELECTRONIC STRUCTURE OF TRANSITION CARBIDES AND NITRIDES
Paul Costa 1967 15 p refs Presented at the Intern. Symp. on Anisotropy of Monocrystal Refractory Compds., Dayton, Ohio, 13–15 Jun. 1967
(ONERA-TP-481(1967)) CFSTI: HC $3.00/MF $0.65

Previous publications have suggested that the band structure of the transition carbides and nitrides might be very similar to the band structure of the transition metals with a narrow, predominantly d, band. In this paper it is shown how this model can be modified to account for NMR experiments by Rossier. Ionic character and d–p hybridization are discussed. Two other parts deal with the existence of ordered structures of interstitial atoms and the validity of the transition metal model for sub-stoichiometric compounds and with recent experiments on semi-carbides. Author (ESRO)

N67-33977# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
INDUCED ACTIVITY OF INDIUM AND CADMIUM THROUGH ^{60}Co PHOTON IRRADIATION
G. Cortellessa, A. Grisanti, and P. Tori 21 Nov. 1966 16 p refs
(ISS-66/46)

Activation of natural indium and cadmium by means of irradiation with ^{60}Co photons is discussed. Preliminary experimental results are presented, together with a brief discussion of dosimetric applications and possible health physics implications. Author (NSA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-32700# Naval Ordnance Lab., White Oak, Md. Chemistry Research Dept.
DEVELOPMENT OF THE CONTINUOUS WIRE METHOD. MEASUREMENTS IN CAST DINA Progress Report
Donna Price, John P. Toscano, and Irving I. Jaffe 20 Apr. 1967 54 p refs
NOLTR-67-10; PR-3; AD-652917) CFSTI: HC $3.00/MF $0.65

Precise continuous wire data obtained from shock-to-detonation transitions in cast DINA show that the voltage-time records cannot be interpreted directly as run length and total delay time. Corrections made for a thick conducting zone of reacted explosive needed to close the wire circuit give reasonable results. Author (TAB)

N67-32760# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
RELATIONSHIP BETWEEN THE MINEX AND THE HELIUM-DRIVEN MODIFIED COKER IN THE MEASUREMENT OF JET FUEL THERMAL STABILITY Technical Report, Oct. 1965–Jul. 1966
Herbert R. Lander, Jr. and Alan E. Zengel Feb. 1967 54 p refs
(AFAPL-TR-67-17; AD-653188) CFSTI: HC $3.00/MF $0.65

Six different jet fuels were tested for their resistance to thermal deposition by two versions of the CRC modified coker and the Minex heat exchanger. The test results are compared by plotting the coker deposit code rating versus coker-preheater-tube wall temperature. The temperature of the tube wall, where large quantities of deposits form, is compared with the temperature of the Minex fuel-out, where tube fouling due to deposits occurs. Fouling is indicated by a change in measured heat transfer coefficient. The relative ranking of the six fuels was the same on the Minex as on the helium-driven modified coker. The pump-driven modified coker, however, gave a relative ranking that correlated with neither the Minex nor the gas-driven coker. It was concluded that the pump-driven modified coker was not a satisfactory test tool for fuels with a resistance to thermal degradation above 500F. It was also apparent that the pump on the coker was affecting the test results when fuels of high thermal stability were tested. The most obvious reason for this effect is that the fuels with thermal stability above 500F were treated to remove trace materials, and that these trace materials provide a degree of boundary lubrication. Without this degree of boundary lubrication, the coker pump may wear and release wear products that affect the test results. Author (TAB)

N67-32982# Stanford Research Inst., Menlo Park, Calif. Chemical Dynamics Dept.
ROLE OF CONDENSED-PHASE REACTIONS IN IGNITION AND DEFLAGRATION OF AMMONIUM PERCHLORATE PROPELLANTS
Henry Wise, S. Henry Inami, and Leonard McCulley 12 May 1967 23 p refs
(Contract Nonr-3415(00))
(SRI-PU-3573; AD-652617) CFSTI: HC $3.00/MF $0.65

The contribution of exothermic, condensed-phase reactions to ignition and deflagration of propellants is examined. Measurements of the rates of heat release, thermal diffusivity, burning rate and ignition are combined to demonstrate the role of reactions in propellants made up of powdered ammonium perchlorate and catalysts. By means of a theoretical analysis, it is found that for the propellants under study a thermal runaway in the condensed phase can account for the ignition phenomena observed. Also, at low steady-state deflagration rates the contribution of the solid-phase reactions can be demonstrated. Some of the propellants quenched during deflagration have shown the existence of a subsurface layer, which is located in a zone at which the temperature has reached the level characteristic of the crystal transition of ammonium perchlorate. Author (TAB)

N67-33148*# Rocketdyne, Canoga Park, Calif.
FLUORINE–HYDROGEN PERFORMANCE EVALUATION. PHASE 1, PART II: NOZZLE PERFORMANCE ANALYSIS AND DEMONSTRATION Final Report
B. J. Waldman and E. B. Shuster Apr. 1967 388 p refs
(Contract NASw-1229)
(NASA-CR-72038; R-6636-2) CSCL 21I

Analytical and experimental studies were performed to establish the deliverable thrust chamber performance of the fluorine/hydrogen propellant combination. Six high area ratio nozzle contours were tested in an altitude simulation facility, and the results were compared to analytical predictions. A new type of nozzle contour, intended to improve delivered performance by encouraging chemical recombination, was designed and experimentally evaluated. Author

N67-33441*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HELIUM PRESSURANT REQUIREMENTS FOR LIQUID-HYDROGEN EXPULSION USING SUBMERGED GAS INJECTION
William R. Johnson Washington, NASA, Aug. 1967 47 p refs
(NASA-TN-D-4102) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An experimental investigation was conducted to determine the helium pressurant requirements for the expulsion of liquid hydrogen by the direct injection of helium into the liquid. As the helium was bubbled up through the liquid hydrogen, hydrogen was vaporized, diffused into the bubbles, and carried into the ullage volume. The prime purpose of this injection technique was to minimize the amount of helium gas required for expulsion by supplementing the helium with vaporized hydrogen. The results showed the helium pressurant to be nearly 100 percent saturated with vaporized hydrogen after expansion into the ullage volume. The degree of saturation obtained was not measurably affected by varying expulsion time, tank pressure level, or initial liquid temperature. Furthermore, the major share of the vaporization and diffusion of hydrogen into the individual helium bubbles occurred immediately upon injection of the bubbles into the liquid. The helium pressurant requirements for the submerged injector were compared analytically with those for a conventional overhead hot-gas injector. The results show that the weight of helium pressurant required for the submerged injection technique is approximately that required for a hot-gas system, but only at low tank pressures and/or low values of NPSP. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-32876# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMMANDERS OF FIERY ARROWS; REMARKS ABOUT ROCKET DESIGNERS AND ROCKETS (SELECTED CHAPTERS)
L. A. Ekonomov 31 Jan. 1967 184 p refs Transl. into ENGLISH from the book "Poveliteli Ognennykh Strel (Slovo o Raketchikahk i Raketakh)" Moscow, Izd.-VO, 1964 200 p
(FTD-MT-66-57; TT-67-62011; AD-652464) CFSTI: HC $3.00/MF $0.65

The principle of the book is not only rockets but rocket masters and enthusiasts. It is shown how the first idea of flight was conceived, how this idea was materialized and converted into the still imperfect rocket design and how the rocket scientists of the 20's, 30's and 40's made further accomplishments, so that in the 50's and 60's artificial earth satellites and manned spaceships could fly. Author (TAB)

N67-33074*# National Aeronautics and Space Administration, Washington, D. C.
IV. AIR-BREATHING PROPULSION SYSTEMS FOR SUPERSONIC AIRCRAFT
Lowell E. Hasel, Willard E. Foss, Jr., and David N. Bowditch (NASA, Lewis Res. Center) *In* NASA, Washington Compilation of papers summarizing some recent NASA Res. on Manned Military Aircraft Oct. 1960 p 57–71 (See N67-33070 19-02)

The state-of-the-art for several propulsion system components is reviewed, and some of the important factors which must be considered during the design of a supersonic propulsion system are pointed out. The discussion is centered around the Mach 3 cruise aircraft and the multimission variable sweep wing. Consideration is given to the research and development that has been conducted in the fields of air inlets and jet exits which enables a reasonably high level of on-design performance to be obtained. In connection with the engines themselves, the turbofan appears to offer a number of significant advantages which makes its development highly desirable. C.T.C.

N67-33243*# Martin Co., Denver, Colo.
ACOUSTIC SCALE-MODEL TESTS OF HIGH-SPEED FLOWS, PHASE II Final Report
E. B. Smith, and W. L. Brown Dec. 1966 119 p refs
(Contract NAS8-20223)
(NASA-CR-87315; CR-66-75) CSCL 21H

A scale-model test program to determine the acoustical field generated by high-chamber-pressure hydrogen-fueled engines in various cluster configurations was conducted. Thirteen acoustic measurements were taken during eleven program firings. The acoustic measurements were divided—four in the near-field and eight in the far-field to calculate the power spectrum and the far-field characteristics as well as obtain the near-field data. Engine data obtained for each firing include mixture ratio, propellant weight flow, total thrust, and chamber pressure. These data were acquired to describe the source characteristics. The acoustic data were analyzed in 1/3-octave bands for study over a frequency range from 50 to 10,000 cps. The power spectrum, acoustic efficiency, and the directivity indices were calculated from the far-field sound pressure level spectra. The near-field decay upstream of the engine exhaust plane and the apparent source location were measured with the near-field data. The characteristics of the acoustic fields were compared with the data from other investigators, using information obtained from undeflected free jets only. The data tabulation from all eleven program firings is included. Author

N67-33275# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLIGHT REGIMES OF A VEHICLE WITH A RAMJET ENGINE WHICH PROVIDE FOR CONSTANT CONDITIONS OF A FLAME STABILIZATION
V. N. Gruzdev and A. V. Talantov 28 Feb. 1967 17 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 4, 1966 p 121–128
(FTD-HT-67-24; AD-653541) CFSTI: HC $3.00/MF $0.65

An attempt is made to find the flight regimes of a vehicle with a ramjet engine which permits operation of the combustion chamber without flameout. The conditions of flame stabilization in a straight-through combustion chamber with the aid of poorly streamlined bodies (mechanical stabilizers) to a significant extent depend on the physical parameters of the mixture that enters the chamber, i.e., pressure and temperature. The latter, in turn, are functions of the flight regime of the vehicle, i.e., the velocity and altitude of flight (M and H). Thus, the conditions of flame stabilization, in the final result, are determined by the flight regime of the vehicle. Author (TAB)

N67-33386*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
TWO-DIMENSIONAL MIXING STUDIES
C. L. Yates, M. Lasky, and J. A. Schetz *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Turbulent mixing, with and without combustion, is being studied to determine scaling laws for mixing, heat transfer, and

skin friction that can be applied to combustor design. The wall-slot injection problem based on a two-layer model of the velocity field was studied; and calculated axial development of displacement thickness Reynolds number and skin coefficient compared with previous results that were obtained independently of the streamwise coordinate origin. Numerical stability considerations required an expanded step-size in integration procedure, and effects of changing the initial step-size are shown. A schlieren photograph of the model flow field shows pitot and cone-static pressure probes mounted in the stream; the weak shock generated within the nozzle because of fault within the nozzle contour is shown, as is the strong shock ahead of the probes caused by flow choking between the probes that are mounted with centerlines one inch apart.
M.W.R.

N67-33462*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF POWER PLANT INLETS [UNTERSUCHUNGEN AN TRIEBWERKSEINLAUFEN]
W. Trommsdorff Aug. 1967 41 p refs Transl. into ENGLISH from the German
(NASA-TT-F-11160; DLR-FB-66-34) CSCL 21H

The requirements for optimum diffusers are investigated. Using a one parameter family of double shock diffusers it is shown that the best efficiency of an appended ramjet of optimum design will not be obtained with a diffuser having the best pressure recovery on account of the associated high external drag. Flow fields are computed for multi-shock diffusers, for most readily fabricated diffusers, and for diffusers with both internal and external isentropic compression. Tests and measurements are performed in the region of medium supersonic velocities. A device for suppressing the diffuser buzz is described. For the case of an axially symmetric diffuser with external compression, a procedure is presented how to adapt the stepped edges of the central body to variable flight Mach numbers.
Author

N67-33751# Ohio State Univ. Research Foundation, Columbus. Energetics Research Lab.
A REVIEW OF THE STATE OF THE ART OF CYCLONE-TYPE SEPARATORS Final Report, Jan.–Jun. 1966
Alfred C. Pinchak Wright-Patterson AFB, Ohio, ARL Mar. 1967 71 p refs
(Contract AF 33(615)-1915)
(ARL-67-0047; AD-653578) CFSTI: HC $3.00/MF $0.65

The report represents a brief review of the state of the art of cyclone type separators which may have application in the gas turbine-dust ingestion problem. Experimental data of various investigators are presented. Emphasis is placed on the interaction between the separation efficiency, flow rate, pressure drop, and geometrical parameters. A simple analytical model provided a means for logically comparing the separators performance reported by different investigators. A review of some recent theoretical advances is also presented. Special consideration is given to the prediction of the fractional separation efficiency and the secondary internal flow patterns. In addition to the standard text references, an extensive bibliography is included which should be of direct relevance to engineers designing high capacity cyclone type separators.
Author (TAB)

N67-33963 Imperial Metal Industries (Kynoch), Ltd., Birmingham (England). New Metals Div.
MECHANICAL PROPERTIES OF A LARGE ENGINE COMPRESSOR DISC IN IMI TITANIUM 679
9 Aug. 1966 9 p

Cut-up test results are presented for a quarter segment of an engine compressor disk in IMI titanium 679, which weighed approximately 100 lb, was 22-in in dia, and had a web thickness of 1-1/2 in and a rim thickness of 3-1/2 in. Tensile and notched tensile tests between room temperature and 840°F show that oil quenching after a 1-hr 1650°F treatment, gives a marked increase in strength over air cooling and no reduction in ductility or notched/plain tensile strength ratio. Difference in strength between 1-1/2-in and 3-1/2-in sections is small, indicating the depth hardening capability of the alloy during oil quenching. While creep strain is a little higher than in the air-cooled specimens, creep properties are still good and a typical strain is approximately 0.1% in 100 hr under a stress of 78.5 ksi.
M.W.R.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-32757*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROBABLE OBSERVATIONS OF THE GEOMAGNETIC TAIL AT 10^3 R_E BY PIONEER 7
Norman F. Ness, Clell S. Scearce, and Sergio C. Cantarano Apr. 1967 26 p refs
(NASA-TM-X-55863; X-612-67-183) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Pioneer 7 passed through the downstream region of solar wind interaction with the geomagnetic field at 900–1050 R_E during September 26 to October 3, 1966. Detailed measurements of the magnetic field suggest that certain of the magnetic lines of force connect to the earth through the geomagnetic tail. A coherent, well-ordered tail with imbedded neutral sheet does not appear to have been observed. This suggests that the geometry of the tail changes to a complex set of intermingled filamentary flux tubes at several hundred R_E.
Author

N67-32795*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONS OF THE POLAR IONOSPHERE IN THE ALTITUDE RANGE 2000 TO 3000 km BY MEANS OF SATELLITE BORNE ELECTRON TRAPS
J. L. Donley Jul. 1967 17 p refs Presented at the COSPAR, London, Jul. 1967
(NASA-TM-X-55851; X-615-67-335) CSCL 03B

Measurements have been made of electron density and temperature and quasi-energetic electron flux by means of planar electron traps employing retarding potential techniques on the Explorer XXXI (DME-A) spacecraft in the altitude range of from 2000 to 3000 km during magnetically quiet periods of December 1965 and January 1966. Observations above 60°N magnetic latitude indicate very low ambient electron densities (N_e<100/cm^3) which are a typical feature of the polar ionosphere at high altitudes. Irregularities and peaks of enhanced ionization are observed. These peaks have widths of up to 1000 km and contain density enhancements on the order of a factor of ten above ambient background. Within the peak there is a change of ionic composition to heavy ions (O^+) from the background composition of light ions (H^+).
Author

N67-32818# Academy of Sciences (USSR), Moscow.
SHORT-WAVE SOLAR STUDIES, STRUCTURE OF SOLAR ATMOSPHERE, AND THE IONOSPHERE
G. S. Ivanov-Kholodny and G. M. Nikolsky *In its* Ionospheric Res. 1965 p 5–8 refs (See N67-32817 19-13)

The determination of the spectrum and of the intensity of the shortwave solar emission is discussed. A reveiw of papers on that subject and results of researches of the ionization rate caused by the shortwave solar emission in the upper atmosphere at different moments of the day are presented. Author

N67-32830# Academy of Sciences (USSR), Moscow.
SOME PECULIARITIES OF MAGNETO-IONOSPHERE DISTURBANCES IN THE FRONT ZONE
Ye. P. Glushkova *In its* Ionospheric Res. 1965 p 104–116 refs (See N67-32817 19-13)

The peculiarities of magneto-ionospheric disturbances in the transition zone, i.e., the latitude belt belonging to middle latitudes but located near the auroral zone are discussed. It is shown that during large and very strong magnetic storms D_s—variations of H and Z components of the geomagnetic field occur in synphase. Phenomena, which are characteristic of the auroral zone disturbances, are observed in the ionosphere. Blackouts are observed only in cases when, during a positive phase of the storm, there is a sudden peak in the H component which warns of the approach of the current system. Besides, the negative phase of the storm should also be well developed. As the transition zone is located approximately in the same latitudes where the outer radiation belt is the closest to the earth's surface, a supposition is offered that a connection is possible between certain phonomena observed during magneto-ionospheric disturbances and movement of particles in the outer radiation belt. Author

N67-32832# Academy of Sciences (USSR) Moscow.
IONOSPHERIC PARAMETERS DEPENDENCE ON SOLAR WAVE EMISSION ENTERING THE EARTH'S ATMOSPHERE
A. I. Likhachov, Yu. N. Yelizaryov, G. V. Yegorova, and N. I. Timchenko *In its* Ionospheric Res. 1965 p 129–140 refs (See N67-32817 19-13)

Materials are presented on the relations of ionization parameters on the level of the F_2 layer with the zenith angle of the sun and the flow of solar energy into the earth's atmosphere. The influence of duration of the sunlit period on the ionization state is shown. Materials are provided on the phenomenon of limitation of the increase of ionization in the F_2 layer, and a possibility is established of the existence in the ionosphere of equilibrium state of the radiation balance type. Author

N67-33291# Uppsala Univ. (Sweden). Inst. of Physics.
AIR PRESSURE DEPENDENCE OF COSMIC RAY INTENSITY. METHODS AND RESULTS OF A STATISTICAL ANALYSIS ON NEUTRON MONITOR DATA
Sten Martinelle Nov. 1966 30 p refs
(Contract AF 61(052)-868)
(SN-2; AFCRL-67-0212; AD-653579) CFSTI: HC $3.00/MF $0.65

A general regression model is derived which describes the dependence of the cosmic-ray neutronic component on the air pressure. As the residuals are correlated the ordinary least-squares method is not the best one to estimate the pressure effect. Alternative methods are discussed. Five methods are used to estimate the pressure coefficient at Uppsala during the years 1957–1964. It turns out that a modified two-station method gives the best result and also that there exists a solar cycle dependence of the pressure coeff. TAB

N67-33341* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CHARGE AND ENERGY SPECTRUM OF HEAVY NUCLEI DURING SOLAR MINIMUM, 1965
N. Durgaprasad and D. V. Reames Jun. 1967 11 p refs
(NASA-TM-X-55867; X-611-67-253) CSCL 20H

The differential energy spectra of H_+ ($Z \geq 20$) and H ($Z \geq 10$) nuclei were measured in a balloon flight at a time close to solar minimum using a nuclear emulsion stack flown at an altitude of 2.7 g/cm^2 from Fort Churchill, Manitoba, Canada on 30th June, 1965. Delta-ray density and residual range measurements on tracks and measurements of change of δ-ray density with track length were used to determine the charge and energy of the nuclei. The measured differential fluxes of H_+ ($Z \geq 20$) and H ($Z \geq 10$) nuclei are 0.0013 ± 0.0006 and 0.0045 ± 0.0010 particles/M^2-sr.-sec. MeV per nucleon in the energy range 300–500 MeV per nucleon and 0.0011 ± 0.0004 and 0.0049 ± 0.0008 particles/M^2-sr.-sec. MeV per nucleon in the energy range 500–800 MeV per nucleon. These results are in agreement with satellite and rocket measurements made in the similar energy range and when compared with low energy measurements indicate an energy spectrum of nuclei that is flatter than those observed during earlier years. Author

N67-33363# Uppsala Univ. (Sweden). Inst. of Physics.
A NEW METHOD OF COMPARING THE PERFORMANCE OF NEUTRON MONITORS
Sten Martinelle Nov. 1960 19 p refs
(Contract AF 61(052)-868)
(SN-2; AFCRL-67-0213; AD-653580) CFSTI: HC $3.00/MF $0.65

A one-factor model is used to compare neutron monitor data from different stations. The method supplies information about the performance of the stations in a concise form allowing for differences in cut-off rigidities. TAB

N67-33493* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROVISIONAL HOURLY VALUES OF EQUATORIAL Dst FOR 1961, 1962, AND 1963
Masahisa Sugiura and Shirley Hendricks Washington, NASA, Aug. 1967 48 p refs
(NASA-TN-D-4047) CSCL 03B

Provisional hourly values of equatorial Dst (Storm Time Variation) are given for the years 1961 to 1963. Magnetic Observatories at Hermanus, Alibag, Kakioka, Apia, Honolulu, San Juan, Pilar, and M'Bour were used for 1961; and Observatories at Hermanus, San Juan, and Honolulu were used for 1962 and 1963. The method of data reduction is similar to that employed for the IGY (International Geophysical Year) data, but several improvements have been made. In particular, the secular change was removed from the data for each station for 1962 and 1963. Author

N67-33532# Cornell Univ., Ithaca, N. Y.
MAGNETIC STORM EFFECTS ASSOCIATED WITH THE TAIL OF MAGNETOSPHERE
W. I. Axford Paris, ESRO, May 1966 20 p refs Presented at the ESRO Colloq. on Auroral and Assoc. Magnetospheric Phenomena at Very High Latitudes, Stockholm, 16–18 Nov. 1965
(ESRO-SN-24) CFSTI: HC $3.00/MF $0.65

The mechanisms which are thought to be significant in the theory of magnetic storms and of the interaction between the solar wind and the magnetosphere are reviewed. The importance of the dissipative component of the interaction is emphasized, and it is argued that this leads to the formation of a pronounced tail to the magnetosphere. It is proposed that the energy stored in the tail ultimately appears in part in the low latitude part of the magnetosphere giving rise to the ring current effect as well as to polar substorms and aurora. The sporadic nature of the polar substorms is suggested to be due to a gross resistive instability of the tail of the magnetosphere which is triggered by changes taking place in the solar wind. Author (ESRO)

N67-33570# Harvard Coll. Observatory, Cambridge, Mass. Solar Dept.
CLASSIFICATION OF SOLAR PROMINENCES FOR SUNSPOT CYCLE NO. 19 (1955–1964)
Donald H. Menzel and F. Shirley Jones Mar. 1967 49 p refs
(Contract AF 19(628)-3322)
(SR-13; AFCRL-67-0209; AD-653573) CFSTI: HC $3.00/MF $0.65

The areas and behavior classifications of the prominences on the sun during Solar Cycle No. 19 are summarized, and a study is presented of the distribution of the various classes with solar latitude. During this solar cycle, 90 per cent of the prominences were of A types in which the material descended from the corona, and 16 per cent were of S types, associated with sunspots. The biggest class of prominences was the ANd or hedgerow type; the smallest, the ASls of loop prominences. The overall trend in prominence areas was thus due mainly to the ANd prominences. North-south asymmetries of the areas reveal that for all classes of prominences together there was a northern excess except for the year 1961. Author (TAB)

N67-33832*# Volt Technical Corp., Washington, D. C.
ON THE ORIGIN OF COSMIC RAYS [O PROISKHZHDENII KOSMICHESKIKH LUCHEY]
V. L. Ginzburg and S. I. Syrovatskiy 8 Aug. 1967 22 p refs Transl. into ENGLISH of a Paper Presented at the 10th Intern. Conf. on Cosmic Rays, Calgary, Canada, Jun. 1967
(Contract NAS5-12487)
(NASA-CR-87183; ST-CR-IGA-10634) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Uniform and local models for metagalactic cosmic rays (the part observed near the earth) are described. Energy, thermal radiation, and other considerations are discussed. Halo, disk, and nonstationary galactic models (the assumption is that cosmic rays formed near the earth were formed in the galaxy) are also discussed. The one with the halo is most probable, but it still has not been demonstrated. L.S.

N67-33971*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
COSMIC RAY OBSERVATIONS IN 1964–1965 WITH MARINER IV
S. M. Krimigis Jun. 1967 16 p refs Presented at the 10th Intern. Conf. on Cosmic Rays, Calgary, Canada, 19–30 Jun. 1967
(Grant NsG-233)
(NASA-CR-80988; Rept.-67-26) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The University of Iowa equipment on Mariner IV, which was launched towards Mars on 28 November 1964, consists in part of two thin window tubes sensitive to electrons of $E_e \geq 40$ keV (Det B) and $E_e \geq 45$ keV (Det A), and a shielded tube (Det C) sensitive to electrons of $E_e > 150$ keV and having a threshold of ≈ 55 MeV for omnidirectional protons. Observations over the period 28 November 1964 to 30 September 1965 have shown the following: (a) Electrons in the energy range $0.40 \leq E_e < 150$ keV were present in the interplanetary medium prior to day 12, 1965 with intensities of ≈ 0.5 (cm^2 sec sr)$^{-1}$. (b) The interplanetary cosmic ray gradient for protons of $E_p \geq 430$ MeV was less than 3 per cent per AU and that the data are consistent with zero gradient. (c) There are large changes in the intensities of protons of $E_p \geq 55$ MeV, but the direction and magnitude of the gradient for such protons were uncertain during solar minimum. The implications of these results are discussed. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-32708# Naval Ordnance Lab., White Oak, Md.
A POWERED FLIGHT SIX-DEGREE-OF-FREEDOM TRAJECTORY PROGRAM FOR AN IBM 7090 COMPUTER
W. E. Degrafft Mar. 1967 93 p refs *Its* Aerodynamics Research Report 275
(NOLTR-66-199; AD-652577) CFSTI: HC $3.00/MF $0.65

The report presents a six-degree-of-freedom trajectory program which describes the flight of a rigid vehicle powered by a solid propellant rocket. The program is written for an IBM 7090 computer operating under the IBSYS monitor. The mathematical formulation of the problem and the computer program itself are presented. The program description includes a FORTRAN listing and instructions for its use. Author (TAB)

N67-32716 Liege Univ. (Belgium). Inst. of Astrophysics.
NITROGEN LINES IN THE INFRARED FRAUNHOFER SPECTRUM. THE SOLAR SPECTRUM IN THE 5577 AND 6300 Å REGIONS
John W. Swensson, Ginette Roland, and Luc Delbouille 31 Dec. 1966 30 p refs
(Contract AF 61(052)-955)
(AFCRL-67-0095; AD-647708) CFSTI: HC $3.00

CONTENTS:

1. NITROGEN LINES IN THE INFRARED FRAUNHOFER SPECTRUM J. W. Swensson 15 p refs (See N67-32717 19-30)

2. THE SOLAR SPECTRUM IN THE 5577 AND 6300 Å REGIONS G. Roland and L. Delbouille 10 p refs (See N67-32718 19-30)

N67-32717 Liege Univ. (Belgium). Inst. of Astrophysics.
NITROGEN LINES IN THE INFRARED FRAUNHOFER SPECTRUM
John W. Swensson *In its* Nitrogen Lines in the Infrared Fraunhofer Spectrum 31 Dec. 1966 45 p refs Submitted for publication (See N67-32716 19-30)
(SR-1)

A table giving laboratory and solar data pertaining to the leading NI multiplets lists 38 lines that have been referred wholly or partly to nitrogen atoms in the atmosphere of the sun. Twenty-eight of the NI identifications are new, but four of these are subject to varying degrees of doubt. The maximum excitation potential for nitrogen lines in the solar spectrum is found to be 12.36 eV, which is 0.6 eV higher than the value previously supposed. Author

N67-32718 Liege Univ. (Belgium). Inst. of Astrophysics.
THE SOLAR SPECTRUM IN THE 5577 AND 6300 Å REGIONS
Ginette Roland and Luc DelBouille *In its* Nitrogen Lines in the Infrared Fraunhofer Spectrum, 31 Dec. 1966 10 p refs Submitted for publication (See N67-32716 19-30)
(SR-2)

Spectra of the forbidden oxygen lines recently obtained with a large prism grating spectrometer are presented, and the instrument is briefly described. The spectrometer has a focal length

of 7.5 meters, and the half width of the instrument profile is 7 mÅ at 5577 Å, and 8 mÅ at 6300 Å. A computer provides expanded scale tracings, showing the OI lines at 5577.341 Å and 6300.311 Å. N.E.N.

N67-32719*# Avco Corp., Lowell, Mass.
A FEASIBILITY STUDY OF AN EXPERIMENT FOR DETERMINING THE PROPERTIES OF THE MARS ATMOSPHERE. VOLUME I: SUMMARY
Steven Georgiev Washington, NASA, Jul. 1967 141 p refs
(Contract NAS2-2970)
(NASA-CR-530) CFSTI: $3.00 CSCL 03B

A feasibility study of a Mars probe for obtaining vertical profiles of pressure, temperature, and density is reported. The most important mission objectives and constraints are summarized. The launch-to-probe/spacecraft separation, probe/spacecraft separation, and probe entry sequences are outlined. The overall probe system is described, and details are given on the entry probe, sterilization canister, probe–spacecraft integration, and the probe, separation, stabilization, and propulsion subsystem. Alternate mission modes and earth entry test program are also covered. It is felt that the engineering feasibility is established and the preliminary design satisfactory. N.E.N.

N67-32785# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INTERNAL MAGNETIC FIELDS OF THE SUN
K. T. Yen Jul. 1966 19 p refs
(R-665D-39)

Analytical solutions for the internal magnetic field of the sun are presented. The solutions are based on the idea that the solar wind originates from the sun's interior. The magnetic field is assumed to be weak throughout the interior of the sun so that its effects on the general physical properties of the sun are small. The magnetogasdynamic equations are used to obtain the magnetic solutions. The general configuration of the magnetic lines given by the present solutions is found to be in agreement with that assumed by Babcock in his study of the sunspots and the 22-year solar cycle. A distinctive feature of the configuration, is the presence of shallow submerged lines underneath the sun's surface. Author (NSA)

N67-32780# Naval Postgraduate School, Monterey, Calif.
AN ELEMENTARY DERIVATION OF THE PRINCIPAL EFFECTS OF THE OBLATENESS OF THE EARTH UPON THE ORBITS OF SATELLITES
John E. Brock 27 Apr. 1967 25 p refs Presented at the Canadian Congr. of Appl. Mech., Quebec, 28 May 1967
(TR/RP-78; AD-653078) CFSTI: HC $3.00/MF $0.65

General formulas for the first-order effects of the oblateness of the Earth upon the orbits of satellites were reported in 1957 by R. E. Roberson and by D. G. King-Hele. Their derivations employed methods which are unfamiliar to those not having studied the mathematics of astronomy. In this Technical Report/Research Paper No. 76, an elementary derivation is given for these useful and important results. Author (TAB)

N67-32921# California Univ., Los Angeles. Dept. of Astronomy.
[SPECTROSCOPIC STUDIES OF A AND B STARS, THEORETICAL AND OBSERVATIONAL STUDIES OF PLANETARY NEBULAE, AND CHEMICAL COMPOSITIONAL STUDIES OF GASEOUS NEBULAE] Final Technical Report
27 Jan. 1967 13 p
(Grants AF-AFOSR-1100-66; AF-AFOSR-83-65)
(AFOSR-67-1065; AD-652281) CFSTI: HC $3.00/MF $0.65

Results are given for spectroscopic studies of A and B stars of peculiar chemical composition: for theoretical and observational studies of planetary nebulae; and, for chemical compositional studies of gaseous nebulae. TAB

N67-32966# RAND Corp., Santa Monica, Calif.
GLOBAL RADIATION EMERGING FROM A RAYLEIGH SCATTERING ATMOSPHERE OF LARGE OPTICAL THICKNESS
Anne B. Kahle May 1967 29 p refs
(Contract F44620-67-C-0045)
(RM-5343-PR; AD-652648) CFSTI: HC $3.00/MF $0.65

Calculations of the total radiation emerging from planetary atmospheres optically thicker than those of the earth. For Rayleigh scattering and Lambert reflectivity, the flux is determined for a wide range of solar elevations, ground reflectivities, and optical depths. For very large surface reflectivities there is more radiation downward onto a planet at the bottom of a thick atmosphere than is received at the top because the radiation that does penetrate undergoes multiple reflection. The total radiation absorbed by the surface plus the corresponding diffuse upward radiation always equals the input flow. Bond albedo is determined by numericaly integration. It approaches the value of the ground reflectivity as optical thickness approaches zero, and approaches 1 as it becomes very large. Author (TAB)

N67-32972* Philco Corp., Palo Alto, Calif. WDL Div.
USER'S MANUAL FOR QUICK LOOK MISSION ANALYSIS PROGRAM
W. S. Bjorkman et al 24 Jan. 1967 87 p refs
(Contract NAS5-3342)
(NASA-CR-87301; WDL-TR-2218) CSCL 22A

Results of a mission analysis program are shown in the form of output formats and relevant details of several sample test cases. The Quick Look Program was designed for feasibility studies of a given mission. Such things as energy requirements as a function of launch dates, launch windows, flight times, and return location are provided by this program. Input options available are described, as well as outputs and output controls for trajectories. Lunar orbiting and Mars orbiting and Earth return missions are used as example test cases. S.P.

N67-32996* Northrop Space Labs., Huntsville, Ala.
PREDICTION OF THE LUNAR THERMAL ENVIRONMENT Summary Report
F. B. Tatom and K. V. Ramakrishna Sep. 1966 178 p refs
(Contract NAS8-20082)
(NASA-CR-87300; TR-292-6-097; TM-203) CSCL 20M

A research effort has been carried out to provide a means of predicting the lunar thermal environment. Attention was directed toward the lunar surface temperature and the surface temperature of objects near the Moon. A digital computer program capable of predicting the lunar surface temperature at any time in the past or future for any point on the Moon was developed. As by-products, the radial temperature distribution beneath the lunar surface, the selenographic coordinates of the subsolar point, and the local zenith angle of the Sun are generated. The most noteworthy feature of the program is its self-sufficiency. The inputs required are basically the location of the point of interest (expressed in selenographic latitude and longitude), the time of interest (expressed in Greenwich Mean Time and calendar date), and the thermophysical properties assumed to exist at the point under analysis. No reference to astronomical tables is necessary. The analytical model, upon which the program is based, consists of two parts. The first part locates the subsolar point, and then calculates the shape factor of the Sun with respect to the point of interest on the lunar surface.

The second part solves the governing heat transfer equations to obtain the surface temperature and the radial temperature distribution beneath the surface. Author

N67-33016*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

ON VON ZEIPEL'S METHOD IN GENERAL PLANETARY THEORY

Jean Meffroy 30 Nov. 1966 85 p refs

(Grant NsG-87-60)

(NASA-CR-87298; SAO Special Rept.-229) CFSTI: HC $3.00/MF $0.65 CSCL 03B

We eliminate, by Von Zeipel's method, the short-period terms of a first-order general planetary theory. The disturbed planet is referred to the orbital plane of the disturbing planet and the longitudes are counted from the longitude of the ascending node of the distrubed planet. The short-period terms arising from the indirect part F_{ij} of the disturbing function and those arising from its principal part F_{ip} are eliminated separately. The first terms are calculated using Newcomb operators, the second using Newcomb operators and Laplace coefficients. The powers of eccentricities and mutual inclination higher than the third are neglected. This elimination reduces the system of canonical equations whose Hamiltonian is F_{ij} to a system whose Hamiltonian F'_{ij} is identically equal to zero. It reduces the system of canonical equations whose Hamiltonian is F_{ip} to a system whose Hamiltonian F'_{ip} is the sum of four secular terms and one long-period term. A numerical check of our formulas has been carried out in the two particular cases of Jupiter perturbed by Saturn, and Mars perturbed by the Earth. Author

N67-33017*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

ON THE DISTRIBUTION OF THE GIBEON METEORITES OF SOUTH-WEST AFRICA

Robert Citron 30 Mar. 1967 41 p refs

(Grant NsG-87-60)

(NASA-CR-87297; SAO Special Rept.-238) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The Gibeon meteorites of Southwest Africa have one of the widest distributions of any known group of meteorites on earth. An attempt is made to record what is currently known about their distribution from available literature and personal interviews with people who participated in the discovery and collection of these meteorites. Information is presented on two large possible impact craters that lie in or near the Gibeon area. Descriptions and photographs of six hitherto unreported meteorites are contained. Possible locations of other unreported Gibeon meteorites are presented. Author

N67-33184*# National Aeronautics and Space Administration, Washington, D. C.

PROBLEMS OF ASTROMETRY

Ye. P. Federov, ed. Washington, NASA, Aug. 1967 124 p refs Transl. into ENGLISH of the book "Voprosy Astrometri" Kiev, Naukova Dumka, 1966

(NASA-TT-F-454) CSCL 03A

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9. A METHOD FOR THE SIMULTANEOUS DETERMINATION OF THE LEVEL CONSTANT AND PERIODIC SCREW ERRORS OF A LEVEL TRIER A. S. Kharin p 102–105 refs (See N67-33193 19-14)

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13. PHOTOELECTRIC DEVICE FOR RECORDING OCCULTATIONS OF STARS BY THE MOON V. G. Burachek p 133–137 refs (See N67-33197 19-14)

N67-33185*# National Aeronautics and Space Administration, Washington, D. C.

REDUCTION OF DECLINATIONS OF PAIRS OBSERVED BY THE ILS FROM 1900 TO 1935 TO A COMMON SYSTEM

S. P. Mayor *In its* Probl. of Astrometry Aug. 1967 p 1–21 refs (See N67-33184 19-30)

It is urgent for the solution of certain astronomical and geophysical problems that the results of the International Latitude Service be reduced to a common system of declinations and proper motions. The declinations and proper motions of 154 star pairs observed from 1900 to 1935 which would be most consistent with observations at Mizusawa, Carloforte, and Ukiah are derived. The method used was similar to that proposed by Ye. P. Fedorov; the errors of declinations and proper motions are adjusted so as to make the value independent of the pair. The results have been reduced to the new constant of aberration and freed from some periodic nonpolar terms. Author

N67-33186*# National Aeronautics and Space Administration, Washington, D. C.

ANALYSIS OF DECLINATIONS OF TALCOTT PAIRS OBSERVED BY THE INTERNATIONAL LATITUDE SERVICE (1935–1940)

N. I. Panchenko and R. I. Popova *In its* Probl. of Astrometry Aug. 1967 p 22–31 refs (See N67-33184 19-30)

The methods by which the Central Bureau of the ILS obtained precise declinations of the pairs to be used in deriving variations of latitude during the period 1935 to 1940 are discussed. The differences of declination corrections, $d\delta_i$, obtained for different

stations, are analyzed, and certain methods of the theory of stationary random processes are applied to this analysis. A correlation of $d\delta_i$ has been revealed which may be due to errors in the adopted scale values adopted by the Central Bureau of the ILS for individual stations. For the real accuracy of the values of $d\delta_i$ to be estimated, they are compared with the corrections to the declinations of the same pairs obtained by E. P. Fedorov. Author

N67-33187*# National Aeronautics and Space Administration, Washington, D. C.

ON THE PROBLEM OF SYSTEMATIC AND LOCAL CORRECTIONS OF DIFFERENTIAL CATALOGS WITH THE UTILIZATION OF OBSERVATIONS OF OBSERVED STARS

A. S. Kharin *In its* Probl. of Astrometry Aug. 1967 p 32–35 refs (See N67-33184 19-30)

A method, whereby not only reference stars, but also observed stars are utilized for deriving the equator point, is discussed. This procedure is shown to be capable of improving the catalog in both systematic and accidental respects. It is concluded that a higher weight should be given to observed stars than has been done up to the present. Author

N67-33188*# National Aeronautics and Space Administration, Washington, D. C.

COORDINATES OF THE POLARISSIMA BD+89°3 FROM OBSERVATIONS WITH THE VERTICAL CIRCLE AT GOLOSEYEVO IN 1954–1962

A. K. Korol' and Ye. M. Nenakhova *In its* Probl. of Astrometry Aug. 1967 p 36–46 refs (See N67-33184 19-30)

A description is given of the methods used for observations of the Polarissima BD+89°.3 with the vertical circle at Goloseyevo. Standard error of one observation is ±0".34. Four series of observations were carried out. Between each two series a displacement of the microscopes was made. When the results had been reduced, utilizing apparent places of the polarissima from Berliner Jahrbuch, a clearly visible annual term was revealed. It disappeared after corrections to the coordinates of the polarissima had been determined and taken into account in a new reduction. The following values of the coordinates have been obtained for the epoch and equinox 1958.0: x = −444".46±0".03 and y = +862".07±0".02. Author

N67-33189*# National Aeronautics and Space Administration, Washington, D. C.

CATALOG OF DECLINATIONS OF KSZ$_2$ STARS IN THE ZONE-12 DEG TO 20 DEG

V. M. Nechayev *In its* Probl. of Astrometry Aug. 1967 p 47–67 refs (See N67-33189 19-30)

Determination of declination of KSZ$_2$ stars in the zone −12° to −20° was carried out with the Repsold meridian circle of the Odessa Astronomical Observatory from 22 October 1958 to 7 May 1961. Observations were made using the differential method. Reference stars were taken from the FK$_3$ and PFKSZ in the zone −5° to −25°. The Zimmermann method was adopted for deriving the instrument system. No allowance was made for slight dependence of the system on the season of observation. The standard error of one observation is ±0".56. The definitive catalog of 1325 stars is given in the system of the FK$_3$. The catalog has been compared directly with the photographic zone catalogs of the Yale Observatory, and through these catalogs with the GC and then with FK$_3$. A systematic difference $\Delta\delta_\alpha$ (K–FK$_3$) is revealed. The difference $\Delta\delta_\delta$ (K–FK$_3$) in the zone of observation is −0".02. Author

N67-33190*# National Aeronautics and Space Administration, Washington, D. C.

PROPER MOTIONS IN DECLINATION OF 125 CIRCUMPOLAR STARS

L. F. Chernyev *In its* Probl. of Astrometry Aug. 1967 p 68–71 refs (See N67-33184 19-30)

Proper motions in declination of 125 circumpolar stars are derived on the basis of catalogs obtained from observations made in 1893–1894, in 1920 and in 1950–1951. All the catalogs have been reduced to the equinox 1950.0 and to the FK$_3$ system. The proper motions were computed analytically, using the method of least squares. Author

N67-33191*# National Aeronautics and Space Administration, Washington, D. C.

MEAN ABSOLUTE MAGNITUDE AND SPACE MOTIONS OF CLASSICAL CEPHEIDS OF GALACTIC POPULATION I

Ye. F. Ludchenko *In its* Probl. of Astrometry Aug. 1967 p 72–83 refs (See N67-33184 19-30)

The mean absolute magnitude and the parameters of the space motion of 40 classical cepheids of population I have been found on the basis of new improved proper motions. The solar apex is determined from the spatial velocities relative to this group of stars. The data obtained are then utilized to compute the mean parallax of the same group of stars, using two different methods. The mean absolute magnitude according to the Stromberg formula has been found in complete agreement with the Kukarkin dependence revised by P. P. Parenago. In addition, the velocity components of these stars are computed in the cylindrical galactic system of coordinates. Dispersion of the components is also estimated. Author

N67-33192*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE DIVISION ERRORS OF THE MERIDIAN CIRCLE OF THE ODESSA ASTRONOMICAL OBSERVATORY IN DEGREE DIAMETERS

Ye. S. Zotayev *In its* Probl. of Astrometry Aug. 1967 p 84–101 refs (See N67-33184 19-30)

The investigation of the graduation errors of the meridian circle of the Odessa Astronomical Observatory was undertaken in order to obtain correction to each individual degree diameter. Bruns' rosette method was followed but modified. The results of the investigation show that the methods of determination of graduation errors, which involve interpolation, lead to corrections of diameters markedly differing from the true ones. For this reason, it is desirable to obtain corrections to each diameter of the graduated circle. Author

N67-33194*# National Aeronautics and Space Administration, Washington, D. C.

TABLES OF ANNUAL VARIATIONS OF THE STAR CONSTANTS a AND a'

M. Yu. Volyanskaya *In its* Probl. of Astrometry Aug. 1967 p 106–111 refs (See N67-33184 19-30)

The tables are computed of the annual variations of the star constants a and a' for the new form of these constants adopted since 1960 in the Astronomical Almanac of the U.S.S.R. Author

N67-33195*# National Aeronautics and Space Administration, Washington, D. C.

USE OF CERTAIN METHODS OF ATTENUATING BRIGHTNESS FOR PHOTOGRAPHIC ASTROMETRIC OBSERVATIONS OF MAJOR PLANETS

R. F. Lysyakova *In its* Probl. of Astrometry Aug. 1967 p 112–124 refs (See N67-33184 19-30)

The following methods of attenuation in application to astrometric observation of major planets are discussed: (1) local desensitization, (2) thin films, and (3) a rotating sector. The images

of a test object on a plate were obtained by using methods (1) and (2), as well as without attenuation, and then examined. Also, photographic observations of major planets were conducted, applying methods (1) and (3). Some conclusions are drawn about the applicability of these methods to astrometrical observations of major planets. Author

N67-33244*# Northrop Space Labs., Huntsville, Ala.
LUNAR ENVIRONMENT ANALYSIS: A SURVEY OF LUNAR SURFACE MODELS
James T. Stanley, Wilmuth C. Lucas, and W. L. Breazeale 11 Nov. 1966 154 p refs
(Contract NAS8-20082)
(NASA-CR-87326; TR-293-6-002E; TR-311) CSCL 03B

Four analytical lunar surface model studies based on the photometric, radar, thermal, and geologic characteristics of the lunar surface are presented. The photometric, radar, and thermal model studies all indicate a porous lunar surface material but do not define it as either cohesive or noncohesive material. The photometric study further indicates that the material is dark, and the thermal study adds that the material is homogeneous to a depth of several meters with no significant amounts of metals such as iron. The geological study draws on the results of the preceding studies and is used as a vehicle for formulating a most probable lunar surface model. The geologic study indicates that there are three major processes (meteoritic impact, volcanic, and gradation) responsible for shaping the lunar surface. In addition, it suggests that the surface material was initially a silicate rock such as basalt; and the present surface configuration is a composite resulting from the meteoritic impact, volcanic, and gradation processes. Author

N67-33278*# National Aeronautics and Space Administration. Goddard Space Center, Greenbelt, Md.
ON THE ELIMINATION OF THE SHORT PERIOD TERMS OF A FIRST ORDER GENERAL PLANETARY THEORY THROUGH VON ZEIPEL'S METHOD
Jean Meffroy 9 Jun. 1967 25 p
(NASA-TM-X-55872; X-641-67-318) CFSTI: HC $3.00/MF $0.65 CSCL 03C

Through Von Zeipel's method, the short period terms of a first order general planetary theory were eliminated; the powers of eccentricities and mutual inclination higher than the third power were neglected; and the Fourier series of the principal part F_{1p} of the disturbing function and the Fourier series of the determining function S_{1p} were reduced to the sum of their three first terms. Results are extended by reducing, more generally, the Fourier series of F_{1p} and that of S_{1p} to the sum of their $2p+1$ first terms ($p>1$). Author

N67-33292# Army Engineer Research and Development Labs.
MINERALOGICAL AND PETROGRAPHIC STUDIES OF SIMULATED LUNAR MATERIAL
O. Fred Kazer May 1967 21 p refs
(Rept.-1899; AD-653618) CFSTI: HC $3.00/MF $0.65

The report is the final report on an in-house research study dealing with the effects of a simulated lunar environment on inorganic terrestrial materials. Author (TAB)

N67-33365*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE LUNAR AND SOLAR PERTURBATIONS IN THE MOTION OF AN ARTIFICIAL SATELLITE DUE TO THE FOURTH DEGREE LEGENDRE POLYNOMIAL
David Fisher Apr. 1967 30 p refs
(NASA-TM-X-55864; X-547-67-201) CSCL 03C

The development of the fourth degree Legendre polynomial is given in separable functions in both coordinates and elements of the satellite and the perturbing body. The result in terms of rectangular coordinates is given as a series containing 13 pairs of functions of the artificial earth satellite and the disturbing body. The results in terms of Keplerian elements are given in thirteen tables which contain functions of the perturbing body as well as functions of the elements of the artificial satellite, and derivatives of these functions. For small eccentricity satellites, the tables may be used to obtain perturbations by either direct integration of the equations of motion or by the method of canonical variables. For satellites of high eccentricity, the tables are used to form Jacobi's determining function and then the perturbations are obtained by the principles of canonical variables. Author

N67-33383*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
TRAJECTORY OPTIMIZATION BY STEEPEST ASCENT METHOD
E. P. Cunningham *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

The steepest ascent method is applied to two problems in trajectory optimization, that is fuel-flow rate was optimized so that a missile would attain a given altitude either (1) in a minimum time or (2) with maximum velocity. For both problems the best fuel-flow rate decreases from the initial maximum; although the final flow rate is almost zero for the minimum time case and reaches a constant nonzero level for the maximum velocity case. Thrust histories and trajectories are given for both problems; and it is noted that the objective of each case is partly attained by the other, i.e., minimum time accompanies velocity increase, and maximum velocity is obtained with decreasing time. Since the final thrust goes to zero in the minimum-time case, the maximum-velocity program is considered the better choice. Optimal flow rate in both problems results in a time decrease of 40 to 50% as compared with the constant flow-rate nominal trajectory. M.W.R.

N67-33418# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
ON THE STRUCTURE OF THE SATURNIAN RINGS
Hannes Alfven Jun. 1967 17 p refs
(Rept.-67-09) CFSTI: HC $3.00/MF $0.65

The structure of the Saturnian rings is usually attributed to resonance effects produced by the innermost satellites. It is shown that this theory is inadequate. It seems unlikely that any force acting today can cause the observed structure. Arguments are given for the view that the ring structure is of cosmogonic origin and has been preserved from the time when the rings and the satellites were formed. The cosmogonic theory of the Saturnian rings is discussed. Both Mimas and the newly discovered Janus seem to have affected the ring structure. The theory leads to the prediction of a new undiscovered satellite moving between Janus and Mimas. Author (ESRO)

N67-33444*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE POTENTIAL FUNCTION AND FIELD OF FORCE OF A SPHEROID
James P. Murphy Jan. 1967 12 p refs
(NASA-TM-X-55858; X-547-67-15) CFSTI: HC $3.00/MF $0.65 CSCL 03C

General formulas are presented for the potential function of a spheroid in rectangular coordinates. The components of the force, the partial derivatives of the potential with respect to the coordinates, are also derived. Author

N67-33448# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
RELATIONSHIP BETWEEN CHANGES IN THE INTERPLANETARY MAGNETIC FIELD AND VARIATIONS IN THE MAGNETIC FIELD AT THE EARTH'S SURFACE
G. Rostoker and C.-G. Faelthammar 26 May 1967 27 p refs
(Rept.-67-10) CFSTI: HC $3.00/MF $0.65

Averaged hourly values of solar wind velocity and the components of the interplanetary magnetic field obtained by IMP–I were combined to obtain the interplanetary electric field as measured in a coordinate system with one axis parallel to the earth's magnetic dipole axis. The hourly values of the azimuthal component of the interplanetary electric field were related to the different types of magnetic activity observed at a world-wide chain of stations. It is found that a positive increment in the azimuthal electric field is strongly related to the initiation of magnetic bay and storm activity, and that establishment of a negative azimuthal electric field causes the recovery phase to be initiated. Sudden impulses are shown to be associated with negative and positive increments in the azimuthal electric field, and are found to be the most common event generated by changes in the interplanetary magnetic field. The possible combinations of solar–terrestrial parameters which determine the different types of magnetic activity are discussed. Author (ESRO)

N67-33521# Stockholm Univ., Sweden. Inst. of Meteorology.
ON THE COLLECTION OF COSMIC DUST SAMPLES FOR CRISTALLOGRAPHIC STUDY
J. F. Kerridge (Birkbeck Coll., London) Paris, ESRO, Apr. 1967 34 p refs Sponsored by ESRO
(ESRO-SN-52) CFSTI: HC $3.00/MF $0.65

Selected area electron diffraction is the only available technique capable of yielding crystallographic information from sub-micron particles such as are found in cosmic dust samples collected from high altitudes. Problems of handling the particles require that they be collected directly on the surfaces upon which they will subsequently be examined. Criteria for the selection of suitable surfaces are discussed and some possible experimental arrangements are assessed both theoretically and on the basis of a series of practical tests. As a result of these investigations the favored arrangement takes the general form of a film of aluminum evaporated on to a bonding medium lying on a firm substrate. The bonding medium is dissolved away following the sampling flight, freeing the aluminium film, with its adhering particles, and allowing it to be mounted in the electron diffraction camera. Author (ESRO)

N67-33534# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
APPLICATION OF THE GRADIENT METHOD TO THE NUMERICAL STUDY OF LIMITED-POWER TRANSFERS BETWEEN NEAR-COPLANAR CIRCULAR ORBITS. COMPARISON WITH LINEARIZED SOLUTION [APPLICATION DE LA METHODE DU GRADIENT A L'ETUDE NUMERIQUE DES TRANSFERTS A PUISSANCE LIMITEE ENTRE ORBITES CIRCULAIRES COPLANAIRES PROCHES. COMPARISON AVEC LA SOLUTION LINEARISEE]
Herve Girard (M.S. Thesis—Ecole Natl. Super. de l'Aeron., Paris) 1967 91 p refs In FRENCH; ENGLISH summary
(ONERA-TN-112(1967)) CFSTI: HC $3.00/MF $0.65

In this analysis the author tries to find, by means of a numerical method, the optimum trajectories for orbital transfers between coplanar circular orbits having nearly the same radius and for power-limited propulsion systems whose ejection velocity may vary. The results obtained are compared to those given by a linearized analytical calculation. The gradient method (which has been retained following an examination of the various applicable methods of optimization) permitted the author for the various radius ratios close to unity, to obtain the transfer trajectories with and without rendezvous and also the corresponding consumption. An examination of these results leads to an evaluation of the validity of the hypothesis of linearization around the initial orbit as a function of the radius ratio. Author (ESRO)

N67-33535# European Space Data Centre, Darmstadt (West Germany).
DETERMINATION OF THE POSITION OF THE SUN ON THE BASIS OF THE MEAN SOLAR ELEMENTS
H. G. Walter and H. K. Schaefer Paris, ESRO, Nov. 1966 13 p refs
(ESRO-SN-10) CFSTI: HC $3.00/MF $0.65

A method is described for calculation of the geocentric rectangular solar coordinates and the geocentric right ascension and declination of the Sun from the mean solar elements; the inertial geocentric coordinate system is used. As compared with the coordinates in the Astronomical Ephemeris, the results are accurate to the third decimal place, which suffices for a great number of investigations into space problems. A computer program has been written for this method. Author (ESRO)

N67-33552*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
LOW-THRUST ORBIT RAISING IN CONTINUOUS SUNLIGHT WHILE THRUSTING IN A PLANE PERPENDICULAR TO THE EARTH–SUN LINE
James R. Ramler Washington, NASA, Aug. 1967 47 p refs
(NASA-TN-D-4104) CFSTI: HC $3.00/MF $0.65 CSCL 22C

An approximate numerical method is derived for determining the motion of an Earth satellite following a tightly wound spiral trajectory which is nearly circular at all times while remaining in continuous sunlight. Thrust is provided by electric rockets and is continuous, tangential, and in a plane perpendicular to the Earth–Sun line. This differs from previous studies which have generally assumed the thrust vector to lie in the orbit plane. The maximum time that the satellite can remain in continuous sunlight has been computed by optimizing the initial orbit inclination and mission starting time for initial thrust-weight ratios from 2.5×10^{-3} to 8.0×10^{-3} and initial orbit altitudes of 300, 500, and 800 nautical miles (555.6, 926.0, and 1481.6 km). Precession of the orbital plane is largely accomplished by utilizing the effects of the oblateness of the Earth. The effect of reversing the thrust direction during the latter part of the mission on the maximum time spent in continuous sunlight has been studied. Methods of solution are discussed and results are presented as curves. Errors in establishing the required initial orbit conditions inherent in any realistic satellite launching are briefly discussed. Author

N67-33584* Boeing Co., Seattle, Wash.
LUNAR ORBITER II. VOLUME VI: APPENDICES
22 Jun. 1967 384 p
(Contract NAS1-3800)
(NASA-CR-66438; D2-100752-6, Vol. VI) CSCL 22A

Appendices tabulating auxiliary data from Lunar Orbiter II are presented. These data include a cross reference index of lunar photos, FPAC supporting data, sequence of events, a summary of anomalies, V/H sensor performance, and telemetered vibration data analysis. C.T.C

N67-33630*# RAND Corp., Santa Monica, Calif.
THREE-DIMENSIONAL NONLINEAR STABILITY ANALYSIS OF THE SUN-PERTURBED EARTH–MOON EQUILATERAL POINTS
Hans B. Schechter Jun. 1967 21 p refs
(Grant NsG-133-61)
(NASA-CR-87312; P-3619) CFSTI: HC $3.00/MF $0.65 CSCL 03C

Results are presented on a nonlinear analytic study of the long period features of the motion of a particle in the Earth–Moon system, near the L_4 libration point. Such long term effects stem from the excitations close to the particle's natural frequencies, introduced by the presence of resonance terms in the internal (Earth and Moon) and external (direct and indirect solar) force fields. The importance of the nonlinear coupling of the out-of-plane motion with the in-plane motion was investigated. The existence of some equilibrium solutions was established, and qualitative and quantitative information concerning the stability of these orbits was also obtained. Author

N67-33642# TUAB Teleutredningar A.B., Solna (Sweden). Space Technology Group.

SOUNDING ROCKET TRAJECTORY DETERMINATION FROM SINGLE STATION RANGE MEASUREMENTS ONLY

Johan Martin-Loef May 1967 24 p refs

(Rept.-67-19) CFSTI: HC $3.00/MF $0.65

A numerical method to estimate the free fall trajectory from slant range observations made by a single range rate station in the launch area is presented. An independent estimate of the flight azimuth is also needed. The tracking can be extended down to the launcher. Errors of ±100 m in altitude and ±500 m horizontally have been obtained. Author (ESRO)

N67-33647# Max-Planck Institut fuer Kernphysik, Heidelberg (West Germany).

MICROMETEORITE STUDIES AT THE MAX-PLANCK-INSTITUT FUER KERNPHYSIK, HEIDELBERG Interim Report

K. Sitte Paris, ESRO, Apr. 1967 38 p refs

(ESRO-SN-18) CFSTI: HC $3.00/MF $0.65

The micrometeorite studies are centered essentially on three problems: microparticle collection, microcrater analysis and microparticle impact registration. As regards microparticle collection, the chief problem is to distinguish between cosmic particles and contamination particles. Unfortunately none of the techniques used so far (double shadowing, chemical analysis, statistics of shapes, statistics of sizes) permits a clear-cut distinction to be made between the two populations. Microcrater analysis is carried out in the form of a simulation process: a Van de Graaff machine accelerates Fe particles onto various targets at velocities determined by means of an electrostatic filter. Electron-microscope examination of the microcraters has made it possible to establish a number of relations between projectile size and velocity, crater depth and diameter, and target material. Author (ESRO)

N67-33665*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

SCIENTIFIC HORIZONS FROM SATELLITE TRACKING

Charles A. Lundquist and Henry D. Friedman, ed. 30 Dec. 1966 257 p refs

(Grants NsG-87-60; NSR-09-015-018)

(NASA-CR-87302; SAO Special Rept.-236) CSCL 03A

A collection of seminar papers which review and explore the research opportunities offered by satellite tracking is presented. The papers cover scientific horizons from tracking space objects, an estimation of scientific parameters, satellite tracking with a laser, the atmospheric effect on laser range determination, present and future research on the upper atmosphere at the Smithsonian Astrophysical Observatory, continental drift, some geophysical implications of the satellite geopotential, the determination of Love's number from satellite observations, relativistic investigations, the motion of the spin axis and the earth's rotation, a review of the earth's rotation, an introduction to the theory of the earth's rotation, an introduction to the theory of the earth's motion about its center of mass, interface with oceanography, a differential orbit improvement program for lunar orbiters, the force function on a lunar satellite due to the moon's oblateness, and the interface of satellite tracking and planetary orbiters. R.N.A.

N67-33686# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

METEORIC PHENOMENA IN THE EARTH'S ATMOSPHERE. INVESTIGATIONS METEOR, NO. 2

B. L. Kaschaev, V. N. Lebedinets, and M. F. Lagutin 1967 261 p refs In RUSSIAN; ENGLISH summary

Radar measurements of radiants and velocities of individual meteors were carried out. The pulse-diffraction method was used to measure velocities; the method of triangular reception of radio-waves reflected from forming meteor trail was used for measuring radiant position. The orbits of 12500 meteor bodies were obtained. Measurements of meteor rates, meteor trail drifts, initial radius of ionized meteor trails were also carried out according to the program of the IGY–IGC. The physical theory of radiometeors is discussed. The ionization curves for meteors being borne by meteor bodies of various masses are obtained. The selectivity of observations in relation to declination of radiants and meteor velocities is discussed. Formulas for receiving density of meteor stream from measured meteor rates are obtained. As the result of the statistical analysis of the orbit catalogue, 195 meteor streams and associations are found. The obtained distribution of orbits of meteor bodies is compared with the results of photographic observations. Author

N67-33682# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

RADAR OBSERVATIONS OF METEORS ON WAVE λ=10 M, NO. 3

E. I. Fialko 1967 41 p refs In RUSSIAN; ENGLISH summary

According to radar observations of meteors on wave λ=10 m during the IGY–IGC (July 1957–December 1959), the averaged diurnal variations of the hour number are drafted, as well as statistical characteristics of meteor echoes: distribution on inclined distances, on lengths, and on intervals between radioechoes. The total length of reflections and the coefficient of filling was found. An evaluation of the coefficient of adhesion in the region of the meteor zone was made. The mean value of the indicator s was determined; this characterises the distribution of meteor bodies according to masses. An interpretation of observation results is given. The major observation results on λ=10 m are compared with the corresponding results obtained during the IGY–IGC in Kharkov, Kazan and at other stations. A brief description of equipment is included. Author

N67-33685# Aerospace Corp., El Segundo, Calif.

ON THE SOLAR DIFFERENTIAL ROTATION AND MERIDIONAL CURRENTS, DECEMBER 1966 THROUGH APRIL 1967

William J. Cocke Apr. 1967 28 p refs

(Contract AF 04(695)-1001)

(TR-1001(2260-01)-2; SSD-TR-67-83; AD-653987) CFSTI: HC $3.00/MF $0.65

The solar differential rotation and large-scale meridional currents are investigated with the axially symmetric, time-independent hydrodynamic equations of motion, including anisotropic convective viscosity forces. The phi-component of the equations of motion is integrated to give a linear, ordinary differential equation determining the angular velocity distribution. The Reynolds number for the differential rotation in the convection zone is shown to be large, and an approximation based on this fact is used to solve the equations of motion to first order, under the assumption that the polar hasting effects are negligible and that the convection zone

is barytropic. A good fit to the observed differential rotation is obtained if the anisotropy parameter satisfies s - 1 approximately equals 1/5; the differential rotation is then approximately independent of the magnitude of the dynamic convective viscosity eta. The circulational velocities near the surface at high latitudes are approximately (s - 1)(1/rho) grad eta. Reasonable agreement with observed values is shown. Author (TAB)

N67-33720 Adelphi Univ. (Australia). Dept. of Physics.
A STRONG X-RAY SOURCE IN THE VICINITY OF THE CONSTELLATION CRUX
J. Harries, K. G. McCracken, R. J. Francey, and A. G. Fenton (Tasmania Univ.) 1967 11 p refs

The detection of a strong source of X-rays in the vicinity of the constellation Crux is reported. X-radiation was also observed from SCO-XR-1, the Sagittarius cluster of sources, the sources in Cygnus, and the sun. The discussion is limited to a description of the X-ray detection system used onboard Skylark rockets, and the establishment of the Crux object's basic properties and its comparison with objects discovered by previous workers. Author

N67-33758 Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DETERMINATION OF MARTIAN AND CYTHEREAN ATMOSPHERIC COMPOSITION WITH AN ENTRY PROBE BY MEASUREMENT OF ULTRAVIOLET AND X-RAY ATTENUATION
F. F. Fish and V. A. Sirounian April 1967 23 p refs
(DAC-60627)

Detailed is the manner in which Martian atmospheric composition and structure can be obtained applying the technique which focuses on the use of ultraviolet and absorption measurements from an entry probe or flyby. Also discussed is the applicability of the technique to studies of the Cytherean atmosphere. S.C.W.

N67-33894# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
ON THE ORIGIN OF THE SOLAR SYSTEM
Hannes Alfven May 1967 18 p refs Presented at the Roy. Astron. Soc., London, 12 May 1967
(Rept.-67-07) CFSTI: HC $3.00/MF $0.65

More experimental knowledge about the behavior of magnetized plasmas as well as the revival of celestial mechanics by computers change the theoretical background of the hypotheses about the origin of the solar system. But the problem remains regarding the state of the solar system at the end of the cosmogonic process and what part of the physical and chemical information derived from the study of the planets, satellites, asteroids, comets and meteors has reference to the cosmogonic process. Emphasis is made on the analysis of physical data like the axial rotation and the orbital elements of celestial bodies. The planetesimal or grain theory of the build-up of planets and satellites leads via the cosmogonic plasma automatically to plasma physics and magnetohydrodynamics. The rapid progress in these fields gives reason to be optimistic about the future of cosmogony. ESRO

N67-33905* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
INFRARED ASTRONOMY: A 20 YEAR PROJECTION
N. J. Woolf and W. F. Hoffmann 24 May 1967 17 p Submitted for publication
(NASA-TM-X-60129) CSCL 03A

Reasons for the importance of infrared astronomy, instrumentation, and the role of ground-based and space-borne projects in infrared astronomy are considered in terms of a 20-year projection of needs and research directions. Detectors of various kinds, atmospheric absorption and emission in the infrared, and the availability of large telescopes and high efficiency infrared spectrographs are discussed. Attention is given to ground-based projects; aircraft, balloon, and rocket flights; satellite studies; and lunar and planetary missions and flybys. M.W.R.

N67-33980*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SURVEY OF THE REGION OF I LACERTA
George Coyne and Jaylee Burley Feb. 1967 41 p
(NASA-TM-X-55718; X-641-67-20) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The distribution of spectral types AO, clustering, and the relative distributions in the region of the association I Lacerta are discussed. The region investigated consisted of sky covering 91.42 square degrees. Photographic magnitudes and spectral classifications were assigned for virtually all stars with $8.5 < m_{pg} < 13.0$ in Areas A, B, and C. For a majority of stars observed neither proper motions, radial velocities, or distances were available, hence it was impossible to determine membership. Spectral classes were determined by using color-equivalents according to the Tikhoff method. The method involved out-of-focus photography for obtaining the spectrum of a star as a continuous series of concentric rings of varying density. Counts indicated that one area, area A, contained a total of 397 A stars in the range $9^m0 < m_{pg} < 13^m0$. Tables containing a comparison of spectral classifications, photometry, and photographic magnitude systems are presented. The number of stars in respective areas of I Lacerta are broken down into tabular form. S.P.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-32709# Air Force Academy, Colo. Frank J. Seiler Research Lab.
TIME-OPTIMAL ATTITUDE CONTROL OF A SPINNING VEHICLE
Dirk H. De Does Mar. 1967 12 p refs
(SRL-67-0004; AD-652221) CFSTI: HC $3.00/MF $0.65

The design of efficient attitude control systems for extra-atmospheric vehicles is of considerable importance. The research discussed in this paper is directed to the problem of re-orienting a spinning vehicle in minimum time. The controllers are assumed to be thrust limited reaction jets (or small rockets). The primary objectives of this research can be summarized as follows: (1) To obtain efficient mathematical techniques for computing the time optimal control law for a wide class of vehicles in which small changes in attitude are required, and (2) to demonstrate the influence of spin rate, vehicle geometry, control magnitude and thruster configuration on the time required to optimally re-orient a spinning vehicle. Author (TAB)

N67-32720*# Boeing Co., Seattle, Wash.
LUNAR ORBITER I, EXTENDED-MISSION OPERATIONS
Washington, NASA, Aug. 1967 22 p
(Contract NAS1-3800)
(NASA-CR-848; D2-100727-4) CFSTI: $3.00 CSCL 22B

On September 14, 1966, Lunar Orbiter I completed its primary mission, and a brief period of experimental effort was expended conducting experiments in addition to star and antenna mapping. The spacecraft met or exceeded specifications for all subsystems except those noted during the photographic mission. No additional anomalies were discovered during the extended period. The thermal control anomaly was the only one that had a significant impact on operations. Thermal control paint continued to degrade. Battery degradation did not become significant until at least 40 orbits later than predicted. Once degradation started, the rate was greater than expected. The thermal control procedure employed during both the photographic mission and the extended mission was to maintain an off-sunline attitude large enough to maintain low temperatures and also small enough to supply adequate solar power. Periodic updating of the attitude control reference was required to prevent drifting outside safe limits. The extended mission phase was terminated 42 days after it started. It is estimated that the impact time was at 13:39 GMT. Author

N67-32848*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MAPPING OF THE EARTH'S BOW SHOCK AND MAGNETIC TAIL BY EXPLORER 33

Kenneth W. Behannon Jul. 1967 76 p refs

(NASA-TM-X-55868; X-612-67-344) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Explorer 33 satellite was launched July 1, 1966 and was injected into a highly elliptical earth orbit. The magnetic field experiment on board the spacecraft consists of a triaxial fluxgate sensor with a maximum dynamic range of ±64 gammas and a sensitivity of ±0.25 gammas along each axis. Because of the initial apogee–earth–sun angle of 118° west of the sun, the first 8 orbits of Explorer 33 (July 1–November 11, 1966) mapped the earth's magnetosheath and magnetic tail from the western flank of the bow shock to the eastern flank. This mapping of the geomagnetic tail out to 80 earth radii established that the tail extends beyond the lunar orbital distance. Explorer 33 has also found that the earth's bow shock is still a detectable boundary between the interplanetary magnetic field and the downstream magnetosheath at a geocentric distance of 75.7 earth radii. This spacecraft has further revealed that the cross section of the geomagnetic tail is probably not cylindrical, and that the magnetic field magnitude in the tail decreases with distance down the tail from the earth. This magnitude decrease can be due both to a gradual expansion of the tail with distance and to a reconnection of magnetic field lines across the tail neutral sheet. Author

N67-32930# Sandia Corp., Albuquerque, N. Mex.

SOME COMMENTS ON THE AERODYNAMIC CHARACTERISTICS OF THE TOMAHAWK SOUNDING ROCKET

Warren A. Curry and James C. Uselton (ARO, Inc.) Mar. 1967 15 p refs Presented at the AIAA Sounding Rocket Vehicle Tech. Spec. Conf., Williamsburg, Va., 27 Feb.–1 Mar. 1967

(Contract AT(29-1)-789)

(CONF-670209-1; SC-R-66-997) CFSTI: HC $3.00/MF $0.65

The Tomahawk sounding rocket, when flown as the second stage of the Nitehawk 9 system, occasionally exhibits a dynamic instability after motor burnout. This instability, which is not related to roll–pitch resonance or roll–pitch lockin, causes extra-atmospheric coning motions of a magnitude several times that which would result from the normal effect of the dynamic pressure gradient. The research being conducted to explain this phenomenon includes studies of the effects of aeroelasticity, and the cross-coupling moments produced by the Magnus effect and asymmetric lee-side vorticity. Analyses of flight test data have yielded information on the extent of vehicle bending, and on the magnitude of the cross-coupling moments. Wind tunnel tests and theoretical studies have provided further information on the cross-coupling contribution. It has not yet been resolved as to which effect predominates. Although the number of cases of adverse coning motion appears to be greater with structurally more flexible systems, it remains to be determined whether the coning is caused primarily by the relaxing of the static moment during bending or by the aggravation of detrimental cross-coupling moments introduced at burnout by flexing and other perturbations. Author (NSA)

N67-33022*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED DYNAMIC MODEL INVESTIGATION OF APOLLO COMMAND MODULE CONFIGURATIONS IN THE LANGLEY SPIN TUNNEL

Henry A. Lee and Sanger M. Burk, Jr. Washington, NASA, Aug. 1967 42 p refs

(NASA-TN-D-3888) CFSTI: HC $3.00/MF $0.65 CSCL 22

An investigation has been conducted in the spin tunnel to determine the dynamic stability of the Apollo command module at low subsonic speeds, both with and without drogue parachutes. The investigation consisted of tests to determine (1) the dynamic stability of the command module alone, (2) the motion of the command module during the deployment of a drogue parachute, (3) the effect of various drogue-parachute configurations on the stability of the command module, and (4) the effect of modifications to the command module to prevent an apex-forward trim condition. The results of the investigation indicated that the command module with blunt end forward was dynamically unstable and could go through rather violent gyrations such as large oscillations, tumbling, and spinning motions if the reaction controls should fail. The command module alone with the apex end forward was dynamically stable and would trim at an angle of attack of about 40° and glide steeply in large circles. Deployment of a drogue parachute would quickly stop any tumbling motions of the command module, and the damping of the residual motions was considerably more rapid if the parachute were attached to the command module by means of a 4-point bridle-type attachment than if it were attached by a 1-point attachment. An apex-forward trim condition on launch abort could be prevented by having the launch escape system attached to the command module and fitting the launch escape system with canard surfaces or with a parachute to cause the configuration to rotate 180° to a blunt-end-forward condition without tumbling. Author

N67-33047*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SIMULATION OF DEPLOYMENT DYNAMICS OF SPINNING SPACECRAFT

William E. Lang and George H. Honeycutt Washington, NASA, Aug. 1967 25 p refs

(NASA-TN-D-4074) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Spin stabilized spacecraft often use the rotational energy of a constrained launch configuration to accomplish change to an orbital configuration of increased inertia and reduced spin rate by sequential or concurrent centrifugal deployment of various appendages. This paper is concerned with evaluation of the dynamic effects of such deployments, particularly the nonlinear transient phenomena generated during periods of variable inertia. Discussed are general principles involving formulations based on energy and momentum conservation, applicable to any case of centrifugal deployment of appendage from a spinning free body. Specific formulation defining transient behavior is developed for two basic systems. The first postulates symmetrical point masses receding radially from a spinning central body, and the second considers point masses constrained to circular arcs coplanar with the spin axis. These basic systems characterize spacecraft having radially telescoping and hinged appendages, respectively. Methods used to derive solutions to these basic systems are discussed, and the applicability of these solutions to the evaluation of more complex

real systems is considered. It is contended that the solutions of the basic systems may suffice by rational extrapolation to yield adequate evaluation of many more complex systems from the viewpoint of critical design criteria. The evolution of testing facilities for subjecting spinning spacecraft to appendage deployment is described and pertinent test experience is reported. Particular attention is given to techniques which may be used to nullify gravity effects and to the significance of this factor. S.C.W.

N67-33440*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF CANARDS IN REDUCING LAUNCH VEHICLE FLIGHT LOADS

Robert W. Cubbison, Kenneth I. Davidson, Raymond A. Turk, and Everett C. Alexis Washington, NASA, Aug. 1967 19 p refs

(NASA-TN-D-4125) CSCL 22D

High structural loadings generally encountered by vehicles traversing the high wind shear regime may be reduced by the use of canards mounted on the launch vehicle. To demonstrate this possibility, a pair of trapezoidal canards mounted on a 1/23-scale model of the Atlas-Centaur-Surveyor configuration was tested in an 8- by 6-foot transonic wind tunnel. Data were obtained over the Mach number range of 0.55 to 1.96 for a model angle-of-attack range of 0° to 10° and canard deflection angle range of 10° to −40°. A rigid body bending-moment analysis was performed to determine the reduction obtainable with canards both in the vehicle bending moments and in engine gimbal requirements. With the relatively small canard surfaces (ratio of canard planform area to reference area, A_c/A_{ref}, 0.226), significant reductions in applied bending moments were obtained over the Mach range investigated. For example, at Mach 1.96 with the canards deflected −40°, the maximum applied bending moment was reduced from 114% to 10% of the design allowable values for 4° angle-of-attack and from 196% to about 100% for a 7° angle-of-attack. Along with the reduction in bending moments, there is a reduction in the engine gimbal requirement. The possibility of reducing engine gimbaling to zero with these canard surfaces was shown for a vehicle angle-of-attack of 5°. Author

N67-33461*# General Dynamics/Convair, San Diego, Calif.

ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME VI—STOCHASTIC EFFECTS

Arthur L. Greensite Washington, NASA, Jul. 1967 129 p refs

(Contract NAS8-11494)

(NASA-CR-825; GDC-DDE66-006) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Analyzed are statistical methods presently being used or methods which are potentially useful in the design of space vehicle control systems. Considered are various random effects that influence overall vehicle performance such as instrumentation noise, parameter uncertainty, and extraneous disturbances. Focused on are three areas where stochastic control principles have been employed to enhance system performance. The first of these deals with instrumentation noise. The classical solution to this problem involved the design of filters to suppress unwanted signals. The features and applications of more sophisticated techniques such as those by Wiener and Kalman are described especially as they pertain to instrumentation noise commonly encountered in space vehicle control systems. A second and related problem is that of separating signal from noise in a generic sense, i.e., when instrumentation noise is not the sole source of extraneous signals. The last area cited where stochastic control principles have been employed focuses on the determination of various control system parameters to minimize some designated error function when parasitic signals are present. Two examples of design tools that have evolved for the rational design of control systems and which are useful in aerospace applications are included. A guide to detailed analysis of specialized cases is also included in an extensive list of references. S.C.W.

N67-33474*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DECONTAMINATION OF THE AIMP-D SPACECRAFT

F. N. Le Doux Apr. 1967 78 p

(NASA-TM-X-55870; X-723-67-171) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Because of the harsh environment of the moon, any contamination of the lunar surface by microorganisms from a spacecraft will remain localized and will not propagate significantly. However, spacecraft are required to be decontaminated biologically to a low level of viable organisms at the time of launch. A procedure was developed to achieve effective microbial decontamination using a decontaminating agent that was compatible with the electronic components, conformal coating, and encapsulation material. Previous tests performed on coupons from control strips indicated that complete immersion and agitation of a module in 90% isopropyl alcohol for a minimum of 15 minutes was a practical method for killing and reducing most vegetative cells, and removing entrapped moisture capable of carrying nutrients. The greatest source of contamination was probably from the technicians, and the debris generated during mechanical integration and assembly. To minimize this a clean room complex was built that allowed for decontamination of spacecraft components, taking biosamples for assaying, and final assembly. The total viable count was determined by adding the counts for various areas at the time of occlusion, the counts for all interior and exterior surfaces, and an estimate of the internal burden of components. Author

N67-33580*# North American Aviation, Inc., Downey, Calif. Space Div.

A STUDY OF ELECTRONIC PACKAGES ENVIRONMENTAL CONTROL SYSTEMS AND VEHICLE THERMAL SYSTEMS INTEGRATION. VOLUME III: TECHNICAL REPORT Final Report

D. J. Watanabe 21 Jul. 1967 602 p refs

(Contract NAS8-20320)

(NASA-CR-87327; SID-67-373-2) CSCL 22B

Technical details, results, and conclusions are presented of a study to determine the optimum thermal conditioning systems for Instrument Unit (IU) electronic packages for Saturn missions ranging from 4-1/2 hours to 180 days. Requirements and constraints imposed by the various missions and vehicle configurations, and by the thermal limits of the astrionic equipment are defined. Current IU astrionic equipment was reviewed to establish possible design improvements based on present technology and on projected new developments. Several conclusions relative to the recommended system concepts are presented, as well as recommendations for future investigations. C.T.C.

N67-33637# European Space Technology Center, Noordwijk (Netherlands).

COMPARATIVE STUDY OF VARIOUS SOUNDING ROCKETS [ETUDE COMPARATIVE DE DIVERSES FUSEES SONDES]

M. Guerin Paris, ESRO, Oct. 1966 22 p In FRENCH; ENGLISH summary

(ESRO-TM-8) CFSTI: HC $3.00/MF $0.65

This study was designed to help experimenters select the type of sounding rocket best suited to the launching of their payloads. The 17 types of rockets considered can be arranged into 3 classes according to caliber and mass of payload. For each of these 3 classes, rocket performance has been plotted, showing how the altitude of the apogee varies with the mass of the payload. Another set of graphs indicate which rocket, in each class, is the most economic for a given payload, under the combined requirements of minimum useful apogee and minimum possible caliber. Author (ESRO)

N67-33649*# National Aeronautics and Space Administration, Washington, D. C.
COMPARISON OF SPIN STABILIZATION (ICARUS CONCEPT) WITH THREE-AXIS STABILIZATION (ISOS CONCEPT) FOR A SOLAR PROBE [VERGLEICH EINER SPINSTABILISIERTEN SONNENSONDE (ICARUS-KONZEPT) MIT EINER DREIACHSEN-STABILISIERTEN SONNENSONDE (ISOS-KONZEPT)]
W. Schafer, W. Kokott, H. Schweig, P. Kleber, and H. Heppekausen Aug. 1967 20 p refs Transl. into ENGLISH from the German (NASA-TT-F-11199) CSCL 22B

A comparison is given of two types of stabilization for spacecraft: spin stabilization with the spin axis perpendicular to the ecliptic plane and three-axis stabilization with the main axis pointing toward the sun, to determine possible differences in spacecraft weight, development cost, and/or scientific value. The analytical results show no major difference between the two types of spacecraft or stabilization modes with respect to weight and development cost, whereas a distinct advantage with respect to scientific results was obtained with a three-axis stabilized craft. Author

N67-33704*# North American Aviation, Inc., Downey, Calif. Space Div.
A STUDY OF ELECTRONIC PACKAGES ENVIRONMENTAL CONTROL SYSTEMS AND VEHICLE THERMAL SYSTEMS INTEGRATION Final Report
D. J. Watanabe 21 Jul. 1967 152 p refs (Contract NAS8-20320) (NASA-CR-87299; SID-67-373-1) CSCL 22B

Significant results and supporting information are presented of a technical study to determine the optimum thermal conditioning systems for Instrument Unit (IU) electronic packages for Saturn space missions ranging from 4-1/2 hours to 180 days. These systems are basic concepts and are optimized on the basis of mission duration, operational temperature limits, and heat dissipation rate of the electronic packages. The study was directed toward uprating the current IU thermal conditioning system, with important considerations including maximum use of existing components, impact of possible design improvements of astrionic equipment, and changing environmental conditions and heat loads. System data in parametric form that were used in establishing the recommended concepts are provided. C.T.C.

N67-33706*# Goodyear Aerospace Corp., Akron, Ohio. Space Systems Div.
LUNAR STAY TIME EXTENSION MODULE (STEM) Final Report, 21 Aug. 1964-20 Aug. 1965
21 Aug. 1965 420 p refs (Contract NAS1-4277) (NASA-CR-66061; GER-12246) CSCL 22B

Results are presented of a program directed toward the design of a lunar shelter module, specifically defined within Apollo Extension System (AES) constraints, for lunar surface mission operations. Design studies were conducted in each subsystem area, and a specific concept of each system was established (shelter, air lock, life support, power system, thermal control, and communications). A system integration effort was conducted to determine the interface of the subsystems and the modifications required to combine these subsystems into a single operational entity. Based on this approach, the basic STEM concept is defined as a 2-man system designed for 8 to 30 days of operation on the lunar surface. C.T.C.

N67-33719 Junkers Flugzeug- und Motorenwerke A. G. Munich (West Germany).
CONTROL AND STABILIZING OF THE LAST STAGE OF RECOVERABLE AERODYNAMIC SPACE TRANSPORTER SYSTEMS [STEUERUNG UND STABILISIERUNG DER END-STUFE VON WIEDERGEWINNBAREN AERODYNAMISCHEN RAUMTRANSPORTER-SYSTEMEN]
Herbert Koenig [1966] 19 p refs In GERMAN Presented at DGRR/WGLR Ann. Meeting, Bad Godesberg, W. Germany, Oct. 1966 (Rept.-66-061)

Based on a relatively simple flight control method, a theory is outlined which meets requirements for lifting reentry within a closely defined recovery zone. The role of reentry guidance in controlling aerodynamic heating of the reentry vehicle is theoretically analyzed. Considered is only the problem of longitudinal stability and control of the vehicle. Requirements and technical limitations set by the maximum heat balance of the vehicle's heat shield are investigated. A temperature constant of 1200°K is assumed optimum for radiative heat exchange, and flight times between 20 and 90 minutes are considered. Provisions are made for automatic and piloted control during reentry. Transl. by K.W.

N67-33759*# National Aeronautics and Space Administration, Washington, D. C.
NASA PREPARES TO LAUNCH FOURTH SURVEYOR
11 Jul. 1967 43 p (NASA News Release—67-172) Available from the Scientific and Technical Information Division CSCL 22B

A general description of the Surveyor D spacecraft and its mission is given followed by a brief review of previous surveyor missions, and detailed descriptions of the spacecraft systems and experiments, the Atlas–Centaur launch vehicle, the ground tracking and communication system, and the spacecraft's trajectory and flight plan. R.N.A.

N67-33828* North American Aviation, Inc., Downey, Calif. Space Div.
A STUDY OF ELECTRONIC PACKAGES ENVIRONMENTAL CONTROL SYSTEMS AND VEHICLE THERMAL SYSTEMS INTEGRATION. APPENDIX: THERMAL ANALYSIS DATA, PART I Final Report
D. J. Watanabe 21 Jul. 1967 519 p (Contract NAS8-20320) (NASA-CR-87308; SID-67-373-3) CSCL 22B

Results of thermal analysis data in the form of CRT plots, are presented. Nearly all of the plots are for 40 hrs of mission time, which was assumed adequate to achieve equilibrium conditions. The plots for periods of less than 40 hrs were due to unexpected difficulties. The plots contain data for the instrument unit total heat load and coldplate heat loads. L.S.

N67-33849*# General Dynamics/Convair, San Diego, Calif.
KICK STAGE STUDY PRESENTATION Technical Report, Jun.–Nov. 1966
D. A. Heald and W. C. Strobl 12 Dec. 1966 84 p (RKS-66-1029)

This presentation summarizes the results of study activities conducted to support the development of a cryogenic kick stage. The discussion covers kick stage study objectives and guidelines, systems design and analysis, fluorine technology, technology gains, missions and performance, program schedule and costs, kick stage economics, and study conclusions. R.N.A.

N67-33853*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTEGRATION PLAN FOR THE RADIO ASTRONOMY EXPLORER (RAE) SPACECRAFT
M. M. Grant and N. J. Piterski Sep. 1966 28 p ref
(NASA-TM-X-55855; X-722-66-459) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A general plan for the electronic systems integration and a guideline for developing detailed test plans to be used during the integration operations are outlined. Pre-environmental and environmental tests, measurements, and calibration are covered. Diagrams of the test control center and the integration group voice links are included. N.E.N.

N67-33870 Hamburger Flugzeugbau G.m.b.H. (West Germany).
INVESTIGATION OF SEPARATION OF ROCKET STAGES IN AN EVACUATED TEST CHAMBER (ELDO A STAGES 2 AND 3) [VERSUCHE ZUR STUFENTRENNUNG IN EINER EVAKUIERTEN PRUEFKAMMER (2. UND 3. STUFE ELDO A)]
Hans Beusse and Helmut Grawe [1966] 20 p In GERMAN Presented at DGRR/WGLR Ann. Meeting, Bad Godesberg, W. Germany, 6 Oct. 1966

The tests are to determine the separation sequence of the third stage from the second stage for the ELDO A launch vehicle/satellite system. This is a simulation of a process that will take place at an altitude of 175 km, at a pressure of $<10^{-5}$ Torr, after the vehicle has traveled 450 km, and while its velocity is 5.9 km/sec. The separation involves activation of the detonator valve, gas generators, acceleration rockets, detonation pin, and structural separation. The experimental arrangement is described; it consists in essence of the test chamber, which is 4 m in diameter, 8 m long, and provides a vacuum of 10^{-1} Torr; the accelerator tracks inside the chamber; the measuring devices and transducers; and the vacuum pumps. Also described are the mockup stages, equipment of the control facility, and apparatus for transport and assembly of the stages. Transl. by K.W.

N67-33893* Boeing Co., Seattle, Wash.
LUNAR ORBITER II. VOLUME III: MISSION SYSTEM PERFORMANCE
24 Apr. 1967 144 p
(Contract NAS1-3800)
(NASA-CR-66437; D2-100752-3, Vol. III) CSCL 22B

The plans for controlling the launch and flight operations of the Lunar Orbiter II Project are outlined. Launch operations discussed include spacecraft processing (hangar S, explosive safe area, and launch pad 13); launch conduct (countdown, weather, tracking and telemetry coverage); and the performances of the Atlas and Agena vehicles. The flight operations plan includes Mission I/Mission II comparisons; a significant events summary; flight path conduct; and spacecraft systems performance during flight. In addition, the ground equipment, ground communication system, SFOF, and software performance of the data system, are discussed. Radiation and micrometeoroid data obtained during Mission II, are given. L.S.

N67-33942# Max-Planck-Institut für Physik und Astrophysik, Munich (West Germany).
PAYLOAD MISSIONS AND CONSTRUCTION OF THE THIRD RUBIS ROCKET [AUFGABEN UND AUFBAU DER NUTZLAST DER DRITTEN RUBIS-FORSCHUNGSRAKETE]
F. Melzner Sep. 1966 9 p In GERMAN Presented at the Ann. Joint Meeting DGRR/WGLR, Bad Godesberg, W. Germany, Oct. 1966 *Its* Paper 66-068
(MPI-PAE/Extraterr.-35/66) CFSTI: HC $3.00/MF $0.65

Data are given on the third rocket of the type Rubis which was launched in April 1966 in the Sahara, and the payload is described. It contained four experiments and for the first time two artificial ion clouds were produced by barium released in 2000 km altitude which allowed the structure of the terrestrial magnetic and electric fields to be investigated. Author (ESRO)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-32699# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
MULTIPOINT INITIATED IMPLOSIONS FROM HEMISPHERICAL SHELLS OF SHEET EXPLOSIVE
Jack E. Kennedy and Irvine I. Glass Jan. 1967 34 p refs
(Contract AF 33(615)-2766)
(UTIAS-TN-99; ARL-67-0018; AD-652195) CFSTI: HC $3.00/MF $0.65

Some preliminary results are given on the generation of implosion waves by simultaneously detonating a hemispherical shell of sheet explosive at 91 individual initiation sites. The 7 in. dia. x 0.168 in. thick shell was formed from eight orange-peel segments cemented on a steel backing shell 0.1 in. thick, which was perforated to take the 91 detonators. A scalloped type shock wave surface was generated from the 91 individual detonation sites that imploded into the gas space. The distortions of the shock wave surface increased as the implosion wave gained in strength while converging on the origin. It would seem from the limited experiments that this may not be a useful way of producing implosions. However, it appears to be a useful method of investigating instabilities of implosion waves arising from controlled disturbances. Author (TAB)

N67-32706# Naval Applied Science Lab., Brooklyn, N. Y.
FATIGUE OF STRUCTURAL ELEMENTS, STUDY OF RESIDUAL STRESSES IN LINEARLY VARYING BIAXIAL STRESS FIELDS Progress Report
Hugo V. Cordiano and Vito L. Salerno 26 Apr. 1967 63 p refs
(PR-2; AD-653068) CFSTI: HC $3.00/MF $0.65

A theory was developed for the calculation of relaxation strains effected by drilling a hole in a plate with a linearly varying stress field. With this theory a technique was developed for the measurement of residual stresses at the toe of tee fillet welds. The above technique was employed for the measurement of residual stresses at the toe of tee fillet welds in 1-1/2 in. HY-80 steel with the fillet in the as welded, ground, shot-peened, ground and shot-peened, and mechanically-peened condition. It was found that experimental data conforms to the assumed theory, and that residual stresses in as welded tee fillet welds in both the transverse and longitudinal directions approach the yield strength of the steel. It was also found that residual stresses are reduced approximately 25 percent by grinding, 50 percent by shot-peening and 80 percent by grinding and shot-peening. Mechanical-peening drastically affected residual stresses by converting high tension at the toe of the fillet weld to high compression of approximately the same magnitude. Author (TAB)

N67-32728# Columbia Univ., New York. Inst. for the Study of Fatigue and Reliability.
RE-EXAMINATION OF MECHANICAL HYSTERESIS Final Report

W. A. Wood Feb. 1967 29 p refs
(Contract Nonr-266(91))
(TR-42; AD-652361) CFSTI: HC $3.00/MF $0.65

Mechanical-hysteresis loops have been obtained for cycles of torsion applied to copper, brass, low-carbon steel, titanium. It is shown that the slope of the unloading line is determined by a plastic recovery p together with elastic recovery e, that p/e is virtually constant for a given amplitude of cyclic twist, that p/e changes systematically with amplitude, and that p/e leads to an effective shear modulus that decreases with increasing amplitude in a specific way for the different metals. It is also shown that the Bauschinger effect leads to yield of a special kind, where for example cyclic torsion and static tension in combination can lead to a non-linear stress/strain relationship without leading to yield in the direction of tension. Author (TAB)

N67-32733# Columbia Univ., New York. Inst. for the Study of Fatigue and Reliability.
SECOND-ORDER STRAIN ACCUMULATION AT ULTRASONIC FREQUENCY
Warren P. Mason, and Maria Ronay May 1967 22 p refs
(Contract Nonr-266(91))
(TR-50; AD-652362) CFSTI: HC $3.00/MF $0.65

Permanent axial extension is produced by reversed cyclic straining in tension-compression at ultrasonic frequency and in torsion at mechanically induced (low) frequency. It is shown that in both ranges the axial extension is a quadratic function of the cyclic strain amplitude, which is characteristic of second-order effects that exist independently of the frequency of the cyclic strain. Author (TAB)

N67-32737 Vereinigte Flugtechnische Werke G.m.b.H., Munich (West Germany).
EXPERIENCES WITH ANALYSES METHODS OF EIGEN AND FLUTTER VIBRATIONS [ERFAHRUNGEN MIT BERECHNUNGSMETHODEN FUER EIGEN- UND FLATTERSCHWINGUNGEN]
Margarete Gerfeld [1966] 23 p refs In GERMAN; ENGLISH summary Presented at DGRR/WGLR Ann. Meeting, Bad Godesberg, W. Germany, Oct. 1966
(Rept.-66-046)

The analysis of eigen and flutter vibrations is represented by a characteristic value problem, namely in matrix notation $(B-\lambda C)=0$. Several direct and iterative methods are described which allow to determine the desired eigenvalues λr and the corresponding eigenvectors X_r $(r=1,2,...,n)$. Decisive points of view in choosing a certain method of solution are the special properties of the problem to be considered together with the task to overcome the numerical and programming difficulties of the mathematical procedures with particular regard to high speed digital computers. Author

N67-32763# Houston Univ., Tex. Dept. of Mechanical Engineering.
CONCERNING THE STABILITY OF A FLEXIBLE SHAFT WITH ONE DISK WHEN ACTED UPON BY THE FORCES OF INTERNAL AND EXTERNAL FRICTION AND BY THE WEIGHT OF THE DISK
A. Tondl May 1967 17 p refs Transl. into ENGLISH Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk (Moscow), no. 1, 1958
(Contract Nobs-88657)
(TR-4; AD-652934) CFSTI: HC $3.00/MF $0.65

The stability of a flexible shaft with a disk in the middle acted upon by the forces of internal and external friction is studied. The regions and conditions for stable motion are identified for a simple model. Author (TAB)

N67-32811# Liege Univ. (Belgium). Laboratoire d'Aeronautique.
BASIS OF A WELL CONDITIONED FORCE PROGRAM FOR EQUILIBRIUM MODELS VIA THE SOUTHWELL SLAB ANALOGIES Report for Jul. 1966–Nov. 1966
Baudouin M. Fraeijs de Veubeke Mar. 1967 29 p refs
(Contract AF 61(052)-892)
(SA-8; AFFDL-TR-67-10; AD-652239) CFSTI: HC $3.00/MF $0.65

Equilibrium models of finite elements have by definition the property of satisfying detailed equilibrium within the structure. Their usefullness lies in their ability to predict upper bounds to influence coefficients. The larger number of nodal displacements but the smaller number of selfstressing states, by comparison with displacement models, suggests the development of a force type program in preference to a stiffness program. The report shows how the Southwell slab analogies between displacement fields in conforming displacement models and stress functions in equilibrium models provide an efficient method for selecting force redundencies and particular equilibrium solutions. The method automatically reduces to a minimum the coupling between the unknowns. Author (TAB)

N67-32815*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRESSES AT THE TIP OF A LONGITUDINAL CRACK IN A PLATE STRIP
W. B. Fichter Washington, NASA, Aug. 1967 57 p refs
(NASA-TR-R-265) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Several plane elastostatic problems involving opening and in-plane shearing of the crack, as well as one plate bending problem, are analyzed. Stress intensity factors are obtained as a function of the ratio of strip width to crack length. In addition, for several problems some plots of the stresses on the longitudinal edges are presented to illustrate some additional effects of the proximity of the crack to the boundary. Finite strip width is shown to exert a strong influence on stress intensity factors in certain ranges of the ratio of strip width to crack length. Results for the fixed-edge plane problems and the plate bending problem are only slightly influenced by changes in Poisson's ratio. The results should be useful in the design of fracture test specimens and in the analysis of fracture test data. Author

N67-32840# IIT Research Inst., Chicago, Ill.
AN EXPERIMENTAL INVESTIGATION OF FRANGIBLE PLATE FRAGMENTATION Final Report
Theodore Liber and Ralph L. Barnett Oct. 1966 106 p
(Contract OCD-PS-64-50)
(AD-653162)

The fragmentation of dynamically loaded homogeneous brittle plates was studied by means of a drop test facility. Multiple tests were conducted on five different size model plaster plates under two loading conditions. The results indicated that the plate response is statistical in nature and that a definite fracture pattern emerges. Furthermore, they give rise to the working hypothesis that the cracks propagate along the maximum stress trajectories associated with the forced vibration mode. Author (TAB)

N67-32851*# Northrop Corp., Hawthorne, Calif. Norair Div.
ANALYTICAL AND EXPERIMENTAL DETERMINATION OF LOCALIZED STRUCTURE TO BE USED IN LABORATORY VIBRATION TESTING OF SHELL STRUCTURE-MOUNTED COMPONENTS, SATURN V. Final Report, Apr. 1966–Jul. 1967
Chintsun Hwang et al Jul. 1967 200 p refs
(Contract NAS8-20025)
(NASA-CR-87160; NOR 67-127) CSCL 20K

Major subjects include the revised finite difference program for localized shell vibration, shell transient and acoustic responses

considering mass attachments, shock and blast overpressure. Also described are the theory and procedure in designing shell scale models.

N67-32904*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
STUDY OF STRUCTURAL WEIGHT SENSITIVITES FOR LARGE ROCKET SYSTEMS. VOLUME 2: DETAILED ANALYSIS AND RESULTS Final Report
7 Jul. 1967 313 p refs
(Contract NAS2-3811)
(NASA-CR-73087 Vol. 2) CSCL 22D

The relative sensitivities of structural weight to variations in design parameters and techniques are evaluated for three baseline vehicle configurations in the million-pound payload class, whose structural design practice and criteria are similar to those used in the Saturn V vehicle. Five other configurations derived from the 201 vehicle were also investigated, holding the thrust, payload, and propellant loading fixed, while varying the fineness ratio, payload density, and tank positions. The analysis procedures and general loads analysis are presented, and optimized structural weight analyses for isotropic and anisotropic materials are discussed. Details are given on unique design approaches. Materials and fabrication processes are covered and structural analysis techniques are evaluated. Extensive tables and diagrams are included. Computer program descriptions, weight/loss matrices, pressure coupling equations, and a factor of safety analysis are appended. N.E.N.

N67-32934# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
ON OVERALL BUCKLING OF VESSELS COMPOSED OF COMBINATIONS OF CYLINDRICAL AND SPHERICAL SHELLS
Azriel Harari Apr. 1967 24 p
(Contract Nonr-266(86))
(TR-42; AD-653114) CFSTI: HC $3.00/MF $0.65

The objective is the determination of the overall buckling load of submerged vessels consisting of combinations of spherical and cylindrical shells. The overall buckling load does not depend substantially on bending effects, such that membrane equations suffice for the purpose of overall buckling. The appropriate differential equations and continuity conditions are derived from the principle of stationary potential energy. Author (TAB)

N67-32939*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
STUDY OF STRUCTURAL WEIGHT SENSITIVITIES FOR LARGE ROCKET SYSTEMS. VOLUME I: SUMMARY Final Report
7 Jul. 1967 39 p refs
(Contract NAS2-3811)
(NASA-CR-73087 Vol. 1) CSCL 22D

Study results are presented for parametric analyses performed with the objective of minimizing structural weight in large launch vehicles of the future. Several advanced structural analysis techniques, materials, and unique approaches to structural design are assessed. Advanced structural analysis techniques such as pressure coupling effects and various biaxial stress field failure theories are considered. Materials including filamentary composites, beryllium, titanium, and aluminum, together with various types of wall construction are considered. Impact of front-end steering, strap-ons, and advanced nozzles are noted. The effects of varying selected design criteria from values in use today are shown. Each new technology or approach is individually applied to several representative vehicles. Structural weights with and without the new technology or approach are compared. Interdependence effects also are investigated. The results may be used to assess the potential of each new technology or approach when applied to large launch vehicles of the future. Author

N67-32954# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EXPERIMENTS WITH ELASTIC COMPLETE SPHERICAL SHELLS OF HIGH RADIUS-TO-THICKNESS RATIO
L. Berke Jan. 1967 25 p refs Prepared jointly with AF Flight Dynamics Lab., Wright-Patterson AFB, Ohio
(SUDAAR-301; AD-652214) CFSTI: HC $3.00/MF $0.65

Tests performed on elastic complete spherical shells of high radius-to-thickness ratio show that buckling under uniform external pressure begins with a small rotationally symmetric dimple. A series of nonsymmetric mode shapes follow, which then dominate both the dynamic and the statically stable post-buckling behavior. Author (TAB)

N67-32977*# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
INTERACTION OF A RING-REINFORCED SHELL AND A FLUID MEDIUM
Jerry W. Berglund and Jerome M. Klosner Jun. 1967 53 p refs
(Contract Nonr-839(40))
(NASA-CR-87174; PIBAL-935; AD-653089) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The work is concerned with the transient dynamic response of a periodically ring-reinforced, infinitely long, circular cylindrical shell to a uniform pressure suddenly applied through the surrounding acoustic medium. The incident particle velocity is zero and the rings are assumed to be slightly flexible. A classical theory of the Donnell type is used to analyze the shell while the fluid is described by the linear acoustic field equation. The solution is obtained by assuming a power series expansion in the ring stiffness parameter and utilizing a technique which reduces the transient dynamic problem to an equivalent steady-state formulation. Numerical results are presented for a steel shell immersed in salt water for different ring spacings. For the case of rigid rings, a cylindrical and plane wave approximation was also used to represent the fluid field. It is shown that the cylindrical wave approximation yields reasonably accurate results. Flexible ring results, although limited, indicate that undamped or nonradiating components of the shell vibration are activated. Author (TAB)

N67-32981# Washington Univ., Seattle. Dept. of Mechanical Engineering.
TRANSIENT ANALYSIS IN FRACTURING ALUMINUM PLATE
A. S. Kobayashi and W. L. Engstrom May 1967 11 p refs
(Contract Nonr-477(39))
(TR-3A; AD-653073) CFSTI: HC $3.00/MF $0.65

Transient displacement distributions in centrally notched aluminum plates with propagating cracks were determined by using the Moire fringe technique. Specimens used were 7075-T6 and 7178-T6 aluminum alloy 4 inches wide, 1/16 inch thick with half crack lengths of 0.12 to 0.25 inches. The transient Moire patterns were recorded with a Beckman and Whitley Model 501A image converter camera. Crack velocities and crack accelerations were determined by utilizing crack wires. Crack velocities in 7178-T6 specimens were higher than those in 7075-T6 specimens. It was also found that the static and transient normal strain distributions in the region immediately ahead of the crack tip were similar. Also with increasing crack velocities, the order of strain singularity approached the order of r to the -0.5 power as found in a previous investigation (see AD-624 168). It was concluded that for the series of experiments, Craggs model of a moving crack agreed with the experimental results. Author (TAB)

N67-32984# Naval Ship Systems Command, Washington, D. C.
EFFECT OF CURVATURE ON THE DISTRIBUTION OF STRESSES NEAR A HOLE IN A CYLINDRICAL SHELL

I. M. Pirogov Apr. 1967 7 p refs *Its* Navships Transl. No. 1035
(TT-67-61962; AD-652366) CFSTI: HC $3.00/MF $0.65

The report considers a solution, with an accuracy up to the fourth power of the indicated parameter, of the problem concerning the concentration of stresses in the area of a small opening on the surface of a thin-walled circular cylinder. In this regard, the function of the stresses utilized in the solution was constructed in the semigeodetic coordinates rho, theta with an accuracy up to the square of the small parameter of beta and rho. Author (TAB)

N67-33064# Argonne National Lab., Ill.
TWO AXISYMMETRIC STEADY-STATE THERMOELASTICITY PROBLEMS FOR TRANSVERSELY ISOTROPIC SOLIDS
Richard A. Valentin Dec. 1966 35 p refs
(Contract W-31-109-ENG-38)
(ANL-7277) CFSTI: HC $3.00/MF $0.65

In connection with a study of the possible utility of anisotropic elastic models in the representation of the internal structure of certain reactor fuel elements, two sample problems are considered to aid in evaluating the analytical and numerical difficulties associated with the introduction of anisotropic effects. Treated are the stress fields associated with a thermal inclusion in the form of a half-infinite circular cylinder in a transversely isotropic space and a traction free, infinite, transversely isotropic, circular cylinder have a particular discontinuous axial surface temperature. Both the isotropic and anisotropic cases are analyzed by means of the stress function formulation of A. Singh. Numerical evaluation of representative stresses are presented for the isotropic case and for a typical transversely isotropic material (magnesium). Author (NSA)

N67-33069# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
TEMPERATURE AND SHRINKAGE (CURING) STRESSES IN THICKWALLED REINFORCED CYLINDER BONDED TO A RIGID CASE
A. M. Freudenthal Feb. 1967 20 p ref
(Contract Nonr-266(78))
(TR-37; AD-652387) CFSTI: HC $3.00/MF $0.65

It is demonstrated by the analysis of a circumferentially reinforced orthotropic elastic thick-walled cylinder bonded to a rigid core and subject to homogeneous shrinkage that the increase in the intensity of the radial tensile stresses as a result of the circumferential reinforcement will produce circumferential delamination unless the tensile strength of the binder matrix is substantially increased. Author (TAB)

N67-33077*# National Aeronautics and Space Administration, Washington, D. C.
VII. SOME STRUCTURAL AND MATERIALS CONSIDERATIONS FOR MANNED MILITARY AIRCRAFT
Eldon E. Mathauser, Richard A. Pride, and Avraham Berkovits *In* NASA, Washington Compilation of Papers Summarizing Some Recent NASA Res. on Manned Military Aircraft Oct. 1960 p 107–127 (See N67-33070 19-02)

The design of lightweight, efficient structures is one of the fundamental requirements for achievement of high performance in military aircraft. In this paper some of the structural and materials considerations that are important to the strength, weight, and integrity of aircraft structures are reviewed. A comparison of some structural materials is made on the basis of weight-strength and tear resistance. In the area of structural design, the relative weights of several types of construction that are of current interest are reviewed and the influence of different materials and the effects of elevated temperatures on structural weight are indicated. Lastly, other factors that are of importance in structural design of future aircraft are discussed. These include strength under nonuniform temperatures, creep, sonic fatigue, and panel flutter. Author

N67-33105# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
A PROBABILISTIC INTERPRETATION OF MINER'S RULE
Sam C. Saunders and Z. W. Birnbaum (Washington Univ.) 30 Apr. 1967 32 p refs *Its* Mathematical Note 505
(Contract Nonr-477(38))
(D1-82-0603; TR-49; AD-652419) CFSTI: HC $3.00/MF $0.65

Miners rule for the cumulative damage due to fatigue, the behavior of which is well known in engineering practice as a deterministic rule, is examined from a probabilistic point of view. By adopting a model for stochastic crack growth with incremental extensions having a distribution with increasing failure rate, and utilizing some results from renewal theory, we exhibit conditions of dependence upon load under which Miners rule does yield the mathematical expectation of the fatigue life. We also obtain conditions of dependence under which it is conservative and others when it is unconservative. The relationships between the mathematical assumptions which govern when the rule is, on the average, conservative or unconservative, are related to the physical conditions in practice which are known to force significant departures from the rule. Author (TAB)

N67-33107# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
A TEST METHOD FOR THE DETERMINATION OF SHEAR MODULUS AND SHEAR STRENGTH Technical Report, 15 Jun.–15 Aug. 1966
Stephen W. Tsai Jan. 1967 15 p refs
(AFML-TR-66-372; AD-652217) CFSTI: HC $3.00/MF $0.65

The report presents a method for determining shear modulus and shear strength of unidirectional fiber-reinforced composites. The method incorporates data from uniaxial tensile and/or compressive tests at fiber orientations of 0, 45, and 90 degrees. The approach presented requires fewer specimens for shear strength determinations than current existing procedures. Author (TAB)

N67-33122 Naval Research Lab., Washington, D. C. Shock and Vibration Information Center
THE SHOCK AND VIBRATION BULLETIN, NO. 36. PART 6: DATA ANALYSIS AND INSTRUMENTATION
Feb. 1967 274 p refs Presented at the 36th Symp. on Shock and Vibration, Los Angeles, 18–20 Oct. 1966; Sponsored by AF
(AD-651403)

Symposium papers are presented on methods of computing and recording data, reducing and analyzing shock and vibration, computer program, and development of instrumentation. For individual titles see N67-33123 to N67-33142.

N67-33123# Allied Research Associates, Inc., Concord, Mass.
EFFECT OF DIGITIZING DETAIL ON SHOCK AND FOURIER SPECTRUM COMPUTATION OF FIELD DATA
M. Gertel and R. Holland *In* NRL Shock and Vibrational Bull., No. 36, Pt. 6 Feb. 1967 p 1–19 refs (See N67-33122 19-32)
(Contract DA-36-038-AMC-3391(A))

A preliminary study of the effects on shock and Fourier spectrum digital computation accuracy due to varying shock record duration and the degree of analog-to-digital conversion has been conducted. Three complex multifrequency, long-duration shock records representative of gunfire shock conditions in armored vehicles

were selected. Shock and Fourier spectra were digitally computed with a range of analog-to-digital point densities of 900 to 10,000 points/sec and arbitrarily selected time durations of 15 to 60 msec for the sample shock records. These results are compared to previously computed reference shock and Fourier spectra obtained for the sample shock records defined by 16,500 to 20,000 points/sec and 60 msec duration. The final results are presented as spectral plots of the percent variation relative to the reference. These plots are called the variation spectra and are useful for estimating the maximum possible error in shock and Fourier spectra computation due to lack of detail in digitizing the shock input. It is concluded that a digital point density of 10,000 points/sec and a record duration of 60 msec are minimally adequate for spectral computations between 10 to 2,000 cps. Author

N67-33129# General Electric Co., Schenetady, N. Y. Research and Development Center.

DETECTION OF LOOSE PARTS AND FREE OBJECTS IN SEALED CONTAINERS

M. W. Schulz et al *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 73–81 (See N67-33122 19-32)

Details are given on the use of the mechanical signature obtained during a vibration test to detect the presence of defects without breaking the seal often found on aerospace electronic packages. In a typical test the package is mounted on the table of a standard vibration exciter and is driven with sinusoidal acceleration of 2 g amplitude at 20 Hz. Above 1 g, any loose particles will bounce around inside the package and generate impacts which can be detected by an accelerometer and displayed by an oscilloscope. Similarly, leads slapping against each other or against nearby panels will produce impacts. The horizontal sweep of the oscilloscope is triggered from the motion of the exciter table. The impacts of a free object are easily seen and readily distinguished from the slapping of leads or the rattle of constrained loose parts such as partially loosened covers or screws. Author

N67-33131# Aerospace Corp., San Bernardino, Calif.

ANALYSIS OF RANDOM VIBRATIONS WITH AID OF OPTICAL SYSTEMS

Ching-u Ip *In* NRL Shock and Vibration Bull. No. 36, Pt. 6 Feb. 1967 p 91–99 refs (See N67-33122 19-32)

Theoretical justification is presented for the use of a coherent optical correlator to analyze rocket noise data and the subsequent structural responses or random vibration problems in general. In support of the idea, brief reviews are presented on Kirchhoff's light diffraction theory, Fraunhofer diffraction pattern, the Fresnel–Kirchhoff diffraction formula, and the Fourier transform relationship in coherent optical systems. It is pointed out that in the data analysis of random vibrations, quantities such as power spectral density, cross-power spectral density, and auto- and cross-correlation functions often require consideration. An example of acoustical or vibration data analysis is included. M.G.J.

N67-33132# David Taylor Model Basin, Washington, D. C.

COMPUTER PROGRAM FOR DYNAMIC DESIGN ANALYSIS METHOD

John H. Avila *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 101–113 refs (See N67-33122 19-32)

The program uses the influence coefficient matrix or stiffness matrix associated with a lumped mass system, together with the masses, to generate the normal modes of vibration and the fundamental frequencies. Of primary importance is the fact that this routine accepts up to 60 degrees of freedom and is generally unaffected by repeated frequencies or frequencies which lie close together. There are capabilities for treating externally redundant systems of certain types, alleviating the work of computing influence coefficient matrices for these cases. Examples of such systems are given. One valuable routine included in this program can examine the input matrix of influence coefficients (or stiffnesses) and test for positive definiteness, i.e., if all eigenvalues associated with the structure model are positive. Furthermore, if the test establishes the existence of negative eigenvalues, the routine locates certain areas of the input matrix where errors are likely to be present. Author

N67-33133# David Taylor Model Basin, Washington, D. C.

COMPUTER PROGRAM FOR GENERAL SHIP VIBRATION CALCULATIONS

Francis M. Henderson *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 115–130 ref (See N67-33122 19-32)

A digital computer program was developed for calculating the approximate steady-state response to harmonic forces and natural frequencies of a system of slender, moderately nonuniform beams with elastic couplings. This system is used to represent a ship hull connected elastically to its propulsion system and to flexibly mounted units (i.e., machinery) which may influence the vibration. The program handles vertical, horizontal, longitudinal (extensional), torsional, coupled vertical-torsion, and horizontal-torsion vibration. Finite-difference equations are used to approximate the systems of steady-state differential equations which the beam system satisfies in each type of vibration. The difference equations are set up by the computer according to a set of lumped elastic and inertial parameters and options supplied as input to the program. These equations are solved (with free-end conditions on each beam) for the mode shapes corresponding to natural frequencies or response patterns for arbitrary frequencies of the exciting forces. Solutions are given in terms of displacement, moment and rotation at discrete points in the beam system. Author

N67-33134# David Taylor Model Basin, Washington, D. C.

MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR TRANSIENT SHOCK ANALYSIS

Anthony C. Melodia *In* NRL Shock and Vibration Bull., No. 36, Pt. 6 Feb. 1967 p 131–162 refs (See N67-33122 19-32)

A computer program is given for a mathematical model used for computing shock and residual shock spectra of linear elastic structures responding to transient forces and foundation motions. A wide range of output options, from tabulated results to a four-coordinate log–log grid, are possible. Included in the mathematical analysis of the shock spectra is a refinement in determining maximum responses which results in a more accurate shock spectrum. The program is written in Fortran IV for the IBM 7090 and includes plotting subroutines for the SC 4020 printer plotter. The program is also coded without the SC 4020 subroutines. Author

N67-33145# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

THE EFFECT OF COUPLE-STRESSES ON SINGULARITIES DUE TO DISCONTINUOUS LOADINGS Research Report

David B. Bogy and Eli Sternberg Dec. 1966 28 p refs (Contract Nonr-220(58))

(TR-9; AD-646680) CFSTI: HC $3.00/MF $0.65

The singularities induced by discontinuous normal or shearing tractions applied to a semi-infinite solid are examined within the two-dimensional linearized couple-stress theory of elastic behavior and are compared with their counterpart in the classical theory of plane strain. A finite jump in the shear loading is found to produce a logarithmic infinity at the load discontinuity in the normal stress acting parallel to the boundary according to both theories. In contrast, a finite jump in the normal loading, according to the couple-stress theory, gives rise to a logarithmic infinity at the load

discontinuity in the shear stress at right angles to the boundary, although all stresses remain bounded in the corresponding classical solution; whereas the conventional theory for this loading case predicts a logarithmic singularity in the rotation field, the latter remains bounded in the modified solution. Author (TAB)

N67-33179# Illinois Univ., Urbana. Dept. of Mechanics.
LIMIT ANALYSIS OF ROTATIONALLY SYMMETRIC SHELLS THROUGH NONLINEAR PROGRAMMING
Andre Biron and Philip D. Hodge, Jr. Oct. 1966 139 p refs
(Contract Nonr-1406(04))
(DOMIIT-1-31; AD-644627) CFSTI: HC $3.00/MF $0.65

A new method of limit analysis of rotationally symmetric shells is introduced whereby lower and upper bounds are obtained through a non-linear programming code. Bounds are found which are sufficiently close together for almost the entire range of the problem parameters for a particular shell configuration, thus yielding results which, in many cases, could not be obtained by standard methods because of mathematical complexities. Author (TAB)

N67-33280# Columbia Univ., New York. Inst. for the Study of Fatigue and Reliability.
SECOND-ORDER ELONGATION OF METAL TUBES IN CYCLIC TORSION
Maria Ronay May 1967 24 p refs
(Contract Nonr-266(91))
(TR-49; AD-653469) CFSTI: HC $3.00/MF $0.65

Aluminum tubes of different wall-thickness are subjected to reversed cyclic torsion of the same amplitude superimposed on the same axial tensile stress. The observed strong dependence on wall thickness of the axial extension accumulating with the number of torsion cycles (cyclic creep) implies that this phenomenon is due to the amplification, by superimposed tension, of accumulating second-order strain increments. Author (TAB)

N67-33321# Naval Air Engineering Center, Philadelphia, Pa.
APPLICATION OF APPLIED-LOAD-RATIO STATIC-TEST SIMULATION TECHNIQUES TO FULL-SCALE STRUCTURES. VOLUME III: EXPERIMENTAL PROGRAM
E. Alter Feb. 1967 64 p refs
(NAEC-ASL-1094, Vol. III; AD-653872) CFSTI: HC $3.00/MF $0.65

The report covers the experimental portion of the current investigation. A total of 14 tests were performed on seven F8U-3 horizontal stabilizers. Specimens were loaded twice to fail in bending: first in the outboard structure, and then in the inboard splice joint. Prescribed load-time and temperature-time programs were automatically controlled. Four steady-state elevated temperature environments were used consisting of uniform and nonuniform temperature distributions up to 425F. All failures occurred in the required locations. Author (TAB)

N67-33324# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.
APPLICATION OF LIFTING-SURFACE THEORY TO THE PREDICTION OF HYDROELASTIC RESPONSE OF HYDROFOIL BOATS Final Report
Charles J. Henry May 1967 56 p refs
(Contract NObs-92423)
(R-1202; AD-653751) CFSTI: HC $3.00/MF $0.65

A theoretical procedure is developed for the prediction of the dynamic response, elastic or rigid body, of a hydrofoil-supported vehicle in the flying condition—to any prescribed transient or periodic disturbance. The procedure also yields the stability indices of the response, so that dynamic instabilities such as flutter can also be predicted. The unsteady hydrodynamic forces are introduced in the equations of motion for the elastic vehicle in terms of the indicial-pressure-response functions, which are derived from lifting-surface theory. Thus, the predicted vehicle-response includes the effects of three-dimensional unsteady flow conditions at specified forward speed. The natural frequencies and elastic modes of vibration of the vehicle and foil system in the absence of hydrodynamic effects are presumed known. A numerical procedure is presented for the solution of the downwash integral equations relating the unknown indicial pressure distributions to the specified elastic-mode shapes. The procedure is based on use of the generalized-lift-operator technique together with the collocation method. Author (TAB)

N67-33330# Sandia Corp., Albuquerque, N. Mex.
METHOD OF APPROXIMATING CUSHION REQUIREMENTS FOR SHOCK ENVIRONMENTS
P. B. Rand Apr. 1967 12 p refs
(Contract AT(29-1)-789)
(SC-DR-67-219) CFSTI: HC $3.00/MF $0.65

A simple method of approximating cushion material requirements for protecting sensitive equipment from damaging shock environments has been developed for materials having nonlinear stress–strain properties. A nomogram is provided as a design aid. Author (NSA)

N67-33338# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
MECHANICAL FORCE GENERATORS USING PERMANENT MAGNETS [GENERATEURS DE FORCES MECHANIQUES A AIMANTS PERMANENTS]
Jean-Francois Boisseau 1967 16 p refs In FRENCH Presented at the 3d Perm. Magnets Days, Paris, 23–24 Feb. 1967; sponsored by Chambre Syndicale des Producteurs d'Aciers Fins et Speciaux and Soc. Franc. des Electriciens
(ONERA-TP-443(1967)) CFSTI: HC $3.00/MF $0.65

Generators giving alternating or slowly evoluting forces, proportional to the control current and independent of the motion of the coils are used in order to determine the vibratory characteristics of mechanical structures. A double C disposition of the magnetic circuit which is constituted of permanent magnets and flat coils characterize these generators whose performance is presented in the case of several configurations. Author (ESRO)

N67-33369*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
RADOME THERMAL STRESS INVESTIGATION
M. B. Tate *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

General and particular series sums for main-body shear and slope are tabulated for computer determinations of convergent series and continuous functions in the main-body thermal stress solution for radomes of interceptor missiles during hypersonic flight. Means of obtaining the series are included. These data are necessary for the structural design and strength determinations for missile operation because the brittle ceramic materials used in the radomes provides little or no stress relief by plastic deformation. M.W.R.

N67-33370*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
VIBRATION STUDIES
N. Rubinstein *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Examination of torsional vibration and bending problems has lead to the development of a computer program that applies

estimation procedures and calculates upper and lower bounds to nonzero bending frequencies of missiles. Missile bending stiffness and mass per unit length, taken to be piecewise constant, are the input data; and the Rayleigh–Ritz procedure is used for the upper bound and the special choice method of Bazley and Fox for the lower bound. The computerized approximation techniques for bound determination will be optimized for use with problems involving elastic structural vibration in missiles. M.W.R.

N67-33372*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
HIGH-TEMPERATURE STRUCTURES AND MATERIALS
M. L. Hill and R. O. Weiss *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Creep strength was tested at 2400° to 3000°F for strips of a high strength refractory alloy composed of 87.5% tantalum–10% tungsten–2.5% hafnium. Stress versus time to 1% creep elongation is graphed; and the resulting data scatter is considered due to the observed variations in grain size. Typical conditions of the coating after tests are shown to be small bubbles that rupture and reseal rather than catastrophic failures. The sample was heated for only 210 sec at 3000°F, and it is speculated that such failure would result in less than 5 min at this temperature. Time for 1% creep elongation for the Ta–W–Hf alloy indicates an alloy twice the strength of an Nb–5V–5Mo–1Br alloy and an Mo-0.5Ti alloy. M.W.R.

N67-33373*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MECHANICAL PROPERTY TESTS ON Al_2O_3 AND SiO_2
W. C. Caywood *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Thin sheets and porous homogeneous cores of alumina sandwiches and monolithic fused silica constructions are being studied in connection with a radome limitation program, during which room temperature moduli of elasticity and rupture as well as thermal expansion were measured. The porous Al_2O_3 has an elasticity modulus 6-1/2 times greater and a rupture modulus 1-1/2 greater than previously reported, while the SiO_2 moduli are less than one-half of those previously found. Thermal expansion for the alumina agrees with previous results, while it is 25 to 30% greater than previously given for nonporous silica. A summary of leading edge materials test is given, and thermal expansion data are plotted. M.W.R.

N67-33374*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THERMAL STRESSES IN SANDWICH SHELLS
J. F. George and L. B. Weckesser *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Thermal stress testing results on an alumina sandwich cone were used to develop theoretical values of internal temperature distribution and thermal stress, and a test specimen that failed because of a local hot spot causing thermal shock is illustrated. Theoretical predictions of temperature distributions through the specimen wall were made by using the external temperature history as a forcer; and these distributions through the wall were used as input for a computer program to determine temperature stress. Test specimens were cut from the failed cone to measure the material properties of the core, and differences between experiment and theory appear to be related to 10% hotter temperature of the inside surface strain gauge element than in the adjacent thermocouple. M.W.R.

N67-33378*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
EXPLOSIVE PROJECTION OF METAL
L. F. Welanetz *In its* Res. and Develop. Programs Mar. 1967 1 p (See N67-33361 19-34)

Effects of geometrical variations in the shape of an explosive device on the direction of projection of the metal casing parts are being investigated in terms of applicability to guided missile warheads; along with the explosive acceleration of the metal and the effect of the interposed inert layers between the explosive and the metal. A 60° pie-shaped sector of explosive Composition C-4, with steel cubes along the circular face and the remaining sides enclosed in steel plates, recorded a cube velocity of 5300 ft/sec. Strike pattern on the target was quite regular; and deformation caused by the explosive was relatively minor, while that by the target impact was large and was accompanied by spalling. The second test with the same composition, but with a cylindrical-faced shape, indicated a rod velocity of 9000 ft/sec. The strike pattern was regular, but the aluminum foil target was destroyed and recovered rod fragments indicated severe breakup but no spalling. The confinement in the second test is considered sufficient to approximate a complete cylindrical warhead, although the hand loading of the plastic explosive is a difficult task. M.W.R.

N67-33416# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS FOR SOLVING PROBLEMS OF STRUCTURAL MECHANICS BY DIGITAL COMPUTER
R. A. Reznikov 7 Dec. 1966 433 p refs Transl. into ENGLISH of the book "Methody Resheniya Zadach Stroitel'noy Mekhaniki na Elektronnykh Tsifrovykh. Mashinakh" Moscow, Izd. Lit. po Stroit., 1964 p 1–335
(FTD-HT-66-270; AD-650490) CFSTI: HC$3.00/MF$0.65

The book deals with applications of high-speed electronic computers to structural mechanics. The information required to understand the operating principles, potential, and methods of utilizing the electronic computers is given in brief form; it is shown how even an elementary method for using computers (application of general mathematical standard routines) permits a new approach to the solution of many complex problems in structural mechanics. Considerable space is devoted in the book to a general algorithm for automating the design of any plane rod system using the method of forces. The design of bar systems (by computer) for natural and forced oscillations, stability, and stable strength is discussed. The book is intended for workers at design and scientific-research organizations in the field of construction, as well as for teachers, graduate students, and students in departments of civil engineering. Author (TAB)

N67-33438 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugzeugbau.
POSTBUCKLING CALCULATION OF THIN-WALLED CIRCULAR CYLINDER SHELLS [NACHBEULRECHNUNG DUENNWANDIGER KREISZYLINDERSCHALEN]
M. Esslinger Mar. 1967 76 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-25)

A numerical method is presented which may be used to calculate the states of equilibrium in the postbuckling region of a perfect thin walled cylinder subject to longitudinal load and radial pressure taking into account the finite length of the cylinder. The method is based on Donnell's shallow shell theory. No further simplifying assumptions have been made. The application of the method is demonstrated with an orthotropic cylinder under axial compression. Author

N67-33448*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
NONLINEAR FLEXURAL VIBRATIONS OF THIN-WALLED CIRCULAR CYLINDERS
David A. Evensen Washington, NASA, Aug. 1967 31 p refs
(NASA-TN-D-4090) CFSTI: HC$3.00/MF$0.65 CSCL 20K

The nonlinear flexural vibrations of thin-walled circular cylinders are analyzed by assuming two vibration modes and applying Galerkin's procedure. This procedure results in two coupled nonlinear differential equations for the modal amplitudes. Only one of these differential equations contains a forcing function, since the applied loading is so chosen that only one mode (the driven mode) receives external excitation. Approximate solutions for the modal response are obtained by the method of averaging. One such solution involves the response of only the driven mode; a subsequent stability analysis shows that this single-mode response is unstable for certain combinations of amplitude and frequency. In this unstable region, it is necessary to consider the coupled-mode response involving both modes, and an approximate solution is presented for this problem. The analysis is in qualitative agreement with the available experiments on the nonlinear vibrations of cylindrical shells, and it exhibits several features that are thought to be characteristic of nonlinear flexural vibrations of thin shells of revolution. Author

N67-33750* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ATLAS FOR THE SOLAR AND LUNAR ORBIT PERTURBATION EFFECTS COMPUTER PROGRAM
Isabella J. Cole May 1967 89 p refs
(NASA-TM-X-55865; X-547-67-212) CSCL 22C

The logic of the subroutines used by the solar and lunar orbit perturbation effect (SLOPE) computer program, along with their relationships to the main program and to each other, is presented. Author

N67-33871* Scientific Translation Service, La Canada, Calif.
OSCILLATIONS OF A VESSEL CONTAINING VISCOUS FLUID [KOLEBANIYA SOSUDA S VIAZKOY ZHIDKOST'YU]
F. L. Chernous'ko Washington, NASA, Aug. 1967 12 p refs Transl. into ENGLISH from Izv Akad. Nauk SSR, Mekh. Zhidkosti i Gaza, no. 1, 1967 p 5–66
(Contract NASw-1496)
(NASA-TT-F-11167) CSCL 20K

Application of equations previously derived by the author to the analysis of the free and forced oscillations of a body with a cavity partially filled with a viscous fluid. The analysis is developed for translational oscillations of the body, in which the characteristic mechanical properties of the system caused by viscosity and the presence of a free surface are revealed best. A solution is obtained for a cavity of arbitrary shape. Several specific cavity configurations are examined. Author

N67-33873* General Dynamics/Convair, San Diego, Calif.
THE STABILITY OF ECCENTRICALLY STIFFENED CIRCULAR CYLINDERS. VOLUME III: BUCKLING OF LONGITUDINALLY STIFFENED CYLINDERS; AXIAL COMPRESSION
G. W. Smith, E. E. Spier, and L. S. Fossum 20 Jun. 1967 205 p refs
(Contract NAS8-11181)
(NASA-CR-87317; GDK-DDG-67-006, Vol. III) CSCL 20K

This volume deals with the buckling of longitudinally stiffened circular cylinders under axial compression. Analysis methods are presented in the forms of procedures, curves, and digital computer programs. These methods apply equally well to cylinders which incorporate only longitudinal stiffening (stringers) and to sections which lie between rings in cylinders having both axial and circumferential stiffening. Application to the latter case is valid only when the critical load for general instability exceeds the critical load for the so-called panel instability mode. Since the contents of this volume are based upon a Donnell-type small-deflection theory, the proposed methods should be used in conjunction with empirical knock-down factors to account for the effects of initial imperfections. In addition, the Donnell assumptions preclude application to non-axisymmetric buckle patterns where the number of circumferential waves is small. Author

N67-33943 Lockheed Missiles and Space Co., Palo Alto, Calif.
VARIATIONAL PRINCIPLES FOR ELASTOPLASTIC MEDIA
L. M. Kachanov 1966 8 p Transl. into ENGLISH from Prikl. Mat. i Mekh (Moscow), v. 6, no. 2, 1962 p 187–196

The variational equations of equilibrium and of motion of a Hencky plastic medium and a strain hardening medium are examined. It has been shown previously that identical assumptions underlie these media. Expressions for the internal energy, plasticity, effective displacement, and hardening states are presented. L.S.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-32712# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
SPECIFIC HEAT RATIOS AND ISENTROPIC EXPONENTS FOR CONSTANT-VOLUME COMBUSTION OF STOICHIOMETRIC MIXTURES OF HYDROGEN–OXYGEN DILUTED WITH HELIUM HYDROGEN
Andre Benoit Jan. 1967 34 p refs
(Contract AF 33(651)-2766)
(UTIAS-TN-102; ARL-67-0017; AD-652194) CFSTI: HC $3.00/MF $0.65

The document is complementary to AD-455747, Thermodynamic and Composition Data for Constant-Volume Combustion of Stoichiometric Mixtures of Hydrogen-Oxygen Diluted with Helium or Hydrogen, by A. Benoit. It includes the calculation of the equilibrium specific heats, the equilibrium specific heat ratios, the isentropic exponents, and the corresponding values of the speeds of sound. For convenience, the final-to-initial temperature ratio and the final-to-initial pressure ratio are also included in the tables. The results are presented for helium and hydrogen dilution respectively. Author (TAB)

N67-32768# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
HEAT CONDUCTION IN MOIST POROUS MEDIA
Yin-Chao Yen Dec. 1966 17 p refs
(CRREL-RR-212; AD-652872) CFSTI: HC $3.00/MF $0.65

An equation has been developed to describe heat conduction in moist porous media. Specific examples are given to demonstrate the effect of dry medium density and water vapor diffusivity through the medium on the rate of temperature propagation in snow. Author (TAB)

N67-32849*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INVERSE PROBLEMS IN RADIATIVE TRANSFER: A REVIEW
Barney J. Conrath Feb. 1967 35 p refs
(NASA-TM-X-55857; X-622-67-57) CFSTI: HC $3.00/MF $0.65 CSCL 20M

An elementary introduction to the inverse problem of radiative transfer as applied to remote measurements of infrared radiation

from planetary atmospheres is presented, along with a review of work which has been done on the problem. Particular attention is given to the problems of inferring vertical temperature profiles and water vapor distributions in the earth's atmosphere. The principle methods which have been developed for solving these problems are discussed briefly. Examples of applications of temperature and water vapor inversions to both synthetic data and data taken with an IRIS instrument at balloon altitudes are presented.

N67-32981# Naval Ordnance Lab., White Oak, Md.
MOLLIER DIAGRAM FOR NITROGEN Final Report
Richard L. Humphrey and Carolyn H. Piper 14 Mar. 1967 45 p refs *Its* Aerodynamics Research Report No. 285
(NOLTR-67-32; AD-652357) CFSTI: HC $3.00/MF $0.65

Thermodynamic data for nitrogen are presented in Mollier diagram form covering the temperature range of 30K to 15,000K and the density range of 0.0000001 to 1000 amagat. Data for the solid and liquid regions are included. The diagram contains all available data of interest to the worker in fluid mechanics and aerodynamics. Speed of sound data are presented on separate charts. Author (TAB)

N67-32984# Institute of Modern Languages, Inc., Washington, D. C.
ON THE SELF-IGNITION OF THERMITE COMPOUNDS
E. I. Maksimov, A. G. Merzhanov, and V. M. Shkiro Ft. Belvoir, Va., Army Eng. Res. and Develop. Labs., Apr. 1967 9 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 40, no. 2, 1966 p 468–470
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1903; TT-67-61921; AD-651970) CFSTI: HC $3.00/MF $0.65

It is proposed that the methods of the theory of a thermal explosion be used to investigate the kinetics of thermite compounds, and the rules governing the ignition of iron-aluminum thermite are cited as an example. Author (TAB)

N67-33015*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SPECTROPHOTOMETRIC MEASUREMENTS OF THE VIBRATIONAL RELAXATION OF CO IN SHOCK WAVE NOZZLE EXPANSION-FLOW ENVIRONMENTS
Anthony L. Russo Jul. 1967 33 p refs
(Contract NASr-109)
(NASA-CR-87276; CAL-AD-1689-A-8) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Infrared and Na line-reversal spectrophotometric methods have been employed for the investigation of the vibrational relaxation of pure CO and 5% CO+95% Ar test gas mixtures behind normal shock waves and in quasisteady expansion flows. The shock wave studies were conducted over a range of equilibrium shocked gas temperatures of about 1400° to 3200°K and pressures of a few atmospheres. Vibrational relaxation times obtained by these two techniques were found to agree quite well and are consistent with other available shock wave data for both test gas mixtures. The expansion-flow results for 5% CO+95% Ar were obtained in a shock-driven conical nozzle for a range of reservoir temperatures of about 3500° to 5000°K and reservoir pressures of about 45 atm. For these experiments the Na line-reversal and CO infrared diagnostic techniques indicated vibrational temperatures much lower than those predicted by the Landau–Teller theory using the shock wave measured rate data. In addition, the infrared measurements indicated somewhat lower vibrational temperatures than the Na line-reversal results. In terms of vibrational relaxation rates, the expansion-flow data indicate that the deexcitation process in the nozzle proceeds about two orders of magnitude faster than anticipated on the basis of the rates measured behind shock waves. Author

N67-33020# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics
THERMODYNAMICS WITH INTERNAL STATE VARIABLES
Bernard D. Coleman and Morton E. Gurtin Dec. 1966 77 p refs
(Contract Nonr-51(31))
(TR-67-15; AD-652588) CFSTI: HC $3.00/MF $0.65

This is a study of the thermodynamics of nonlinear materials with internal state variables whose temporal evolution is governed by ordinary differential equations. After employing a method developed by Coleman and Noll to find the general restrictions which the Clausius–Duhem inequality places on response functions, we analyze various types of dynamical stability that can be exhibited by solutions of the internal evolution equations. We also discuss integral dissipation inequalities, conditions under which temperature can be associated with internal states, and the forms taken by response functions when the material is a fluid. Author (TAB)

N67-33101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSACTIONS OF THE KAZAN AVIATION INSTITUTE, NO. 66, 1961 Selected Articles
22 Mar. 1967 26 p refs Transl. into ENGLISH from Tr. Aviats. Inst. (Kazan), no. 66, 1961 p 73–82, 111–116
(FTD-MT-65-469; TT-67-62017; AD-652473) CFSTI: HC $3.00/MF $0.65

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2. X-RAY INVESTIGATION OF SURFACE LAYER OF CERTAIN HEAT-RESISTING ALLOYS AFTER HEAT TREATMENT IN VARIOUS GAS MEDIA V. V. Zhukov and A. A. Nilov p 13–18 refs (See N67-33103 19-17)

N67-33102# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF HEAT EMISSION FROM CYLINDERS DURING FREE MOVEMENT OF AIR IN RAREFIED SPACE
A. K. Rebrov *In its* Trans. of the Kazan Aviation Inst., No. 66 22 Mar. 1967 p 1–11 refs (See N67-33101 19-33)
The design of high altitude flight vehicles requires extensive research in the physics of heat transfer in rarefied space and the development of engineering methods for calculating the thermal conditions of equipment which operates at high altitudes. This article investigates the heat radiation from cylinders in rarefied space for the purpose of clarifying the peculiarities of low pressure heat transfer and to establish calculation relationships. The experiments were conducted in a vacuum installation with a steel cylinder. The results of analysis of heat radiation from horizontal cylinders under various conditions are presented. Author

N67-33121# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics.
SOME PROPERTIES OF GASES WITH VIBRATIONAL RELAXATION WHEN VIEWED AS MATERIALS WITH MEMORY
Bernard D. Coleman (Mellon Inst.) and Morton E. Gurtin Feb. 1967 25 p refs
(Contract Nonr-51031)
(Rept.-67-13; AD-652586) CFSTI: HC $3.00/MF $0.65

In recent years there has been developed a general thermodynamics of materials for which the stress, temperature, and

energy depend on the histories of the strain and another variable, such as the entropy. Here we discuss the compatibility of that thermodynamical theory with a special theory of mechanical dissipation which has been successfully used in physical gas dynamics: the theory of gases with vibrational relaxation. Granting, without detailed study, certain technical points involving the uniqueness and stability of solutions of a class of non-linear integral equations, we observe that the theory of relaxing gases can be imbedded in the framework of the thermodynamics of materials with memory, provided only that we identify the temperature of the thermodynamical theory with the translational or (active-mode) temperature of the internal-relaxation theory. Author (TAB)

N67-33147*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
VAPORIZATION OF HIGH-TEMPERATURE POTASSIUM IN FORCED CONVECTION AT SATURATION TEMPERATURES OF 1800° TO 2100°F
J. A. Bond and G. L. Converse Washington, NASA, Jul. 1967 258 p refs
(Contract NAS3-2528)
(NASA-CR-843) CFSTI: $3.00 CSCL 20M

The results of an experimental investigation of heat transfer and fluid flow during forced convection vaporization of high temperature potassium in vertical up-flow in single tubes are presented. The experiments were conducted in a Cb-1% Zr facility with radiant-heated test sections at saturation temperatures up to 2100°F. Two-phase heat transfer results are presented for nucleate boiling and the critical heat flux condition, along with exploratory measurements of transition boiling, film boiling and superheated vapor heat transfer coefficients. Measurements of pressure drop in adiabatic two-phase flow, liquid heat transfer coefficients measured at low Peclet numbers, and results from tests with net liquid superheat exploring some of the instabilities associated with boiling inception are also presented. Author

N67-33158*# Wheeler Labs., Inc., Great Neck, N. Y.
SUMMARY OF THE DEVELOPMENT OF OPTICAL WAVEGUIDES AND COMPONENTS
E. Ronald Schineller Washington, NASA, Aug. 1967 61 p refs
(Contract NAS12-2)
(NASA-CR-880; Rept.-1471) CFSTI: $3.00 CSCL 09A

An overview is presented on the design, fabrication, and testing of laboratory models of single-mode waveguides and components for laser systems analogous to waveguide systems at microwave frequencies. Fabrication techniques were examined with the objective of developing compact, rugged optical components which are insensitive to environmental conditions. Based on a theoretical analysis of various configurations, the dielectric waveguide was found to be the most attractive due to low loss and adaptability to component design. Experimental models implemented with liquid and solid materials for the core and cladding were found to be in excellent agreement with theory in waveguide sizes up to 100λ. The unique attributes of optical waveguides are assessed in relation to alternative free space or beam techniques for constructing optical systems. Waveguide filter properties and their application in actual systems are discussed, and summary data are provied on the design and experimental evaluation of lasers, modulators, directional couplers, filters, and detectors fabricated in single-mode waveguide. M.G.J.

N67-33208# California Univ., Livermore, Lawrence Radiation Lab.
THERMODYNAMIC PROPERTIES OF MATTER
M. van Thiel and A. Kusubov *In its* Phys. Dept. Rept., Jun.-Sep. 1966 Sep. 1966 p 40-47 refs (See N67-33206 19-23)

In an investigation of the thermodynamic properties of matter, new and improved bounds were obtained in the fugacity and number density expansions of pressure. The results apply to a system of particles whose interparticle potential energy is non-negative and which has a finite second virial coefficient. Experimental work was conducted on the magnetization and conductivity of iron from 300 kbar to 1250 kbar. Equation of state measurements were derived on rare-earth metals, and the elastoplastic wave structure in aluminum generated by a tangentially accelerated flying plate was studied. R.U.

N67-33225# Los Alamos Scientific Lab., N. Mex.
TABLES OF PARA-HYDROGEN DATA IN ENGINEERING UNITS FROM 36° TO 5000°R AT PRESSURES TO 5000 PSIA
Otis A. Farmer 5 May 1967 159 p refs
(Contract W-7405-ENG-36)
(LA-3689)

Tables of thermodynamic-transport and related properties of para-hydrogen are provided in engineering units for the temperature range 36 to 5000°R and the pressure range 13 to 5000 psia. Author (NSA)

N67-33232*# Oklahoma State Univ., Stillwater.
EDUCATIONAL MONOGRAPH PREPARED FROM CALCULATION OF RADIANT HEAT EXCHANGE BY THE MONTE CARLO METHOD
J. A. Wiebelt Sep. 1966 25 p refs
(Contract NSR-37-002-045)
(NASA-CR-67256; ASME Paper-65-WA/HT-54) CSCL 20M

The Monte Carlo Method of solving radiant heat transfer problems basically consists of following groups of photons around through a system until they are either absorbed or lost. By using a large number of photon groups the statistical behavior of the large group will approach the behavior of an actual system. The technique required to select photon groups, such that a given statistical distribution will be achieved is discussed. An example problem is included, which shows how the Monte Carlo technique can be used to solve problems where energy is emitted and reflected in a non-diffuse or non-specular method. In particular, it is assumed that the Fresnel type surface is present. The Fresnel surface distribution is used as an example problem. Author

N67-33253# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.
PROJECTILE IMPACT INITIATION OF CONDENSED EXPLOSIVES
Milton L. Weiss and Elton L. Litchfield Jul. 1967 21 p refs
(BM-RI-6986)

The projectile impact sensitivity of explosives by subjecting explosive samples to the impact of metal projectiles fired from a 0.50-caliber gun was studied. The projectiles, in the form of right cylinders, made plane surface to plane surface contact with the explosives. Pressures in the explosives were investigated with an expendable pressure transducer in some instances. The physical model of the projectile-explosive interaction describes, in principle, the duration of the peak shock pressure in terms of the projectile and explosive geometry and the steady-state penetration of the explosive. Of the explosives studied, liquid hydrogen–solid oxygen and liquid oxygen–solid or liquid hydrocarbon fuel were the most shock sensitive (requiring an initiating shock of about 1.0 kb or 987 atmospheres pressure); cast TNT was the least sensitive (requiring an initiating shock of more than 110 kb pressure). Measurements of pressure in the explosive showed some moderate space resolution by the transducer and gave pressure distributions in agreement with expectations from the model of the shock processes. Author

N67-33279# Commissariat a l'Energie Atomique, Grenoble France.
VOLTAGE STABILIZATIONS FOR HIGH TEMPERATURE FURNACE
Jacques Huet Oct. 1966 10 p refs In FRENCH; ENGLISH summary
(CEA-R-3050) CFSTI: HC $3.00/MF $0.65

The stabilization of furnace temperatures in the range 1500–2500°C has been achieved by controlling the effective (rms) value of the supply voltage of the heating element. Temperature variations are less than, or equal to, 1°C in the whole working range of the furnace. Two types of set-ups have been developed; one is static, the other makes use of a servomotor. Author

N67-33286# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
FORCED CONVECTION OF AMMONIA. FIRST PART: LIQUID AMMONIA. SMALL TEMPERATURE DIFFERENCES BETWEEN THE FLUID AND THE WALL [CONVECTION FORCEE DE L'AMMONIAC. PREMIERE PARTIE: AMMONIAC LIQUIDE. CAS DE FAIBLES ECARTS DE TEMPERATURES ENTRE FLUIDE ET PAROI]
Paul Perroud, Jean Rebiere, and Alain Rowe Dec. 1966 48 p refs In FRENCH; ENGLISH summary Supported by Direc. des Rech. et Moyens d'Essais
(CEA-R-3088)

Experiments were performed in a cylindrical smooth inconel tube: 3 mm ID, 3.5 mm OD, electrically heated (50 Hz) along 300 mm length. Pressure varied from 5 to 100 bars (P_c=113 bars) mass velocity from 40 to 500 g/cm^2.s, inlet temperature from 33°C to 95°C, heat fluxes to 315 W/cm^2, maximum wall temperatures 850°C, quality 0 to 0.80. The correlation $Nu = CRe^{0.8} Pr^{0.4}$ is found available for homogeneous liquid-phase heat transfer coefficients with C=0.021. Influences of P, G, t_e and x on critical heat fluxes is discussed. A correlation is chosen for the negative qualities. For positive qualities a different correlation is given. Two-phase pressure drops can be calculated by Martinelli–Nelson method with a good approximation. Experimental results are presented in tables (burn-out) and measured temperatures profiles are separately published. Author

N67-33322# RAND Corp., Santa Monica, Calif.
CONVECTION IN A BOX: LINEAR THEORY
Stephen H. Davis Jun. 1967 45 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5251-PR; AD-653924) CFSTI: HC $3.00/MF $0.65

The linear stability of a quiescent, three-dimensional rectangular box of fluid heated from below is considered. It is found that finite rolls (cells with two nonzero velocity components dependent on all three spatial variables) with axes parallel to the shorter side are predicted. When the depth is the shortest dimension, the cross-sections of these finite rolls are near-square, but otherwise (in wafer-shaped boxes) narrower cells appear. The value of the critical Rayleigh number and preferred wave number (number of finite rolls) for a given size box is determined for boxes with horizontal dimensions h, $1/4 = \text{or} < h/d = \text{or} < 6$, where d is the depth. Author (TAB)

N67-33323# RAND Corp., Santa Monica, Calif.
THE INVARIANT IMBEDDING EQUATIONS FOR THE DISSIPATION FUNCTIONS OF AN INHOMOGENEOUS FINITE SLAB WITH ANISOTROPIC SCATTERING
R. Bellman, H. Kagiwada, R. Kalaba, and S. Ueno Jun. 1967 28 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5146-PR; AD-653923) CFSTI: HC $3.00/MF $0.65

This report considers the absorption of photons incident to an atmosphere, to the case of an inhomogeneous atmosphere and anisotropic scattering. By use of the invariant imbedding technique, two complete sets of integro-differential equations are derived—the first for the case of monodirectional illumination of the upper boundary, and the second for monodirectional illumination of the lower boundary—using the equations of transfer and taking into account the polarity of the optical properties of the atmosphere. In both sets, the equations and results for scattering and transmission in the homogeneous case reduce to those given by Chandrasekhar. TAB

N67-33371*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
TRANSPIRATION COOLING INVESTIGATIONS
R. W. Allen and R. W. Newman *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

A test apparatus to measure the mass discharge rate and internal static pressures along the axis of a 1/4-inch OD, 2-micron porous tube was modified by substituting a cylindrical mass discharge sampling device for the straight rubber hose previously used. This resulted in a rate that is an average circumferential value, a nearly constant sampling area when the tube is moved, and a measurement accuracy of ±2% over the range of 0.6×10^{-4} to 2.5×10^{-4} lb/sec per inch of porous tube length. Measurements indicated a highly nonuniform distribution, presumably due to extremely irregular tube porosity. Stainless steel tubes were purchased with 0.4-inch OD, 0.16-inch ID, and 1-micron porosity; and for these a linear variation of mass flow with pressure was found, and the internal pressure variation in the axial direction was small compared to the internal static pressure level. A computer program was prepared to aid in computation of tube friction factor with suction, and a method for attaching end fittings to the porous tubes was determined. M.W.R.

N67-33375*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
HYPERSONIC LEADING EDGE STRUCTURES AND MATERIALS
M. L. Hill *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

Aerodynamic factors that affect the performance of hypersonic leading edges up to about 4000°F are considered in terms of material capabilities. Recovery pressure behind the bow shock reaches 860 psi at sea level, and aerodynamic shear forces of up to 60 psi occur on wedges aft of the cylindrical tip. Bending stresses within the material, due to unsymmetrical loads resulting from a 3-deg angle of attack, reach 7200 psi at sea level; and cold wall heat fluxes of about 7000 Btu/ft^{2}sec are found at sea level. Thermal gradients exist as a function of distance from the stagnation point because of decreased heat transfer. Testing results are given for various leading edges materials, at wedge angles between 15 and 90 deg; along with details of their composition and resulting damage. M.W.R.

N67-33378*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THERMAL EXPLOSION ANALYSES
M. H. Friedman *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

An approximate solution for critical slab hot-spot size is shown to exist for the entire range of practical thermal explosion problems; and an approximate explicit equation for critical hot-spot size is derived that predicts to within 7% of values obtained by exact numerical solutions of the defining nonlinear partial differential equation. Equations used in the solution are given, including those which reduce the hot-spot problem to an algebraic one that must be subjected to iteration and the approximation. M.W.R.

N67-33384*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SUPERSONIC COMBUSTION (ANALYSIS)
F. S. Billig *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

A comparison is made of two types of flow models that use the combustion process to assist in the engine compression; and both methods are found to partially relieve the geometric constraints of a fixed-geometry engine required to operate at different flight Mach numbers. While there are differences in operation, the kinetic energy efficiency of the compression process decreases with increasing diffusion in both of the models, the two-stream and the combustor-shock models. A comparison of the compression models is graphed for scramjet performance at Mach 5. The two-stream model is somewhat better, although the difference between the two is significant only at large values of the minimum contraction ratio. The combustor-shock model has the advantage of being directly considered as a dual mode subsonic–supersonic combustion engine simply by increasing the shock strength to a normal shock. M.W.R.

N67-33385*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
TURBULENT MIXING (ANALYSIS)
J. A. Schetz *In its* Res. and Develop. Programs Mar. 1967 2 p refs (See N67-33361 19-34)

An eddy viscosity model was investigated, and approximate methods for solving differential equations of motion were considered for predicting free turbulent mixing processes that will aid in determining required length and optimum shape of the combustor for a scramjet engine. The relaxation of the restrictive assumption of flow similarity is used in the treatment of the free mixing problems; and a typical actual flow field showing velocity defect regions due to boundary layers and finite splitter plate thickness is depicted. A single form for the eddy viscosity model that can be applied throughout the flow is given that is equivalent to the classical Prandtl model and is an extension of Clauser's boundary layer model. M.W.R.

N67-33395*# Miami Univ., Fla. Center for Theoretical Studies.
A STATISTICAL APPROACH TO THE THEORY OF INTERFACIAL CONDUCTIVITY I
Hannelore Sexl and Roman U. Sexl July 1967 27 p refs
(Contract NAS8-20126; Grant NGR-10-007-010)
(NASA-CR-87316; CTS-SSP-87-1) CSCL 20M

A simple model of the contact between two surfaces is given, taking into account the statistical features of this contact. A theory of interfacial thermal (or electrical) conductivity is based on this model. The information that enters our theory is the height distribution of the asperities on the surfaces. For some simple distributions the heat flow is calculated as a function of the applied pressure, taking into account elastic as well as inelastic deformations of the surfaces. For more realistic height distributions the required integrals can easily be evaluated numerically. Author

N67-33398*# Florida Univ., Gainesville. Dept. of Aerospace Engineering.
HEAT TRANSFER IN A PLANE INCOMPRESSIBLE LAMINAR JET
Knox Millsaps and Norman L. Soong Feb. 1967 9 p refs
(Grant NsG-642)
(NASA-CR-87311) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Using the velocity components derived by Bickley from a physical formulation due to Schlichting, the thermal distribution in a plane incompressible laminar jet is determined by reducing the energy equation to an ordinary differential equation by a similarity transformation. The reduced equation is solved in terms of associated Legendre functions for all Prandtl numbers, and solutions are derived for particular Prandtl numbers by elementary methods. Some numerical results are presented. Author

N67-33420* Scientific Translation Service, La Canada, Calif.
TEMPERATURE DEPENDENCE OF HEAT CAPACITY AT CONSTANT PRESSURE AND CALCULATION OF THERMODYNAMIC VALUES. II CALCULATIONS OF THERMODYNAMIC VALUES AND EQUILIBRIUM CONSTANTS OF THE CHEMICAL REACTIONS [ZAVISIMOST' TEPLOYEMOKOSTI PRI POSTOYANNOM DAVLENII OT TEMPERATURY I RASCHET TERMODINAMICHESKIKH VELICHIN. II. RASCHETY TERMODINAMICHESKIKH VELICHIN I KONSTANT RAVNOVESIYA KHIMICHESKIKH REAKTSITY]
L. B. Gorbunov Washington, NASA, Jul. 1967 5 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 41, no. 2, 1967 p 343–345
(Contract NASw-1496)
(NASA-TT-F-11158) CFSTI: HC $3.00 CSCL 20M

Approximate formulas are derived for calculating thermodynamic characteristics and equilibrium constants of chemical reactions by using the empirical dependence of isobaric heat capacity on absolute temperature. The reaction forming iron oxide at temperatures of 200, 400, 600, and 800°C is used as an application of this approximation method, which is shown to produce results that compare favorably with those obtained by precise calculations. M.W.R.

N67-33426# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
LOW TEMPERATURE SPECIFIC HEAT OF CARBIDES V_2C, Nb_2C, Mo_2C, AND VMoC [CHALEUR SPECIFIQUE ELECTRONIQUE DES CARBURES V_2C, Nb_2C, Mo_2C ET VMoC]
Rene Caudron, Paul Costa, and Bernard Saulgeot 1967 10 p refs In FRENCH; ENGLISH summary Presented at the 2d Intern. Colloq. on Solid Compds. of Transition Elem., Groningen, Netherlands, 12–16 Jun. 1967
(ONERA-TP-480(1967)) CFSTI: HC $3.00/MF $0.65

Specific heat measurements from 3° to 9°K were carried out on Nb_2C, V_2C, (V–Mo)$_2C$, and Mo_2C specimens. The corresponding electronic specific heat coefficients are 0.839, 2.26, 3.16, and 2.93. These results suggest that a minimum of density of states might appear for the semi-carbides between the IVth and Vth column. This could be related with the occurrence of a minimum on the VIth column for the pure metals (cubic centered) and on the IVth for face centered cubic carbides. A progressive displacement depending on the carbon concentration could therefore be suggested, and that seems rather unsensitive to the crystal structure. Author (ESRO)

N67-33433# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES Quarterly Progress Report, Oct. 28, 1966–Jan. 25, 1967
Mar. 1967 37 p refs
(Contract AT(04-3)-189)
(GEAP-5441; QPR-9) CFSTI: HC $3.00/MF $0.65

Results of isokinetic probe measurements of the nine-rod steam–water tests are described. Single-phase sample flow was measured for various values of pressure difference between probe and channel. The calculated sample flow rate, assuming a loss at probe inlet equal to 75% of the calculated laminar flow inlet loss, is in good agreement with the measured rate. Two-phase sample flow rate and enthalpy were measured. Attention was focused on

flow in Subchannel No. 1, bounded by the corner rod and the channel corner. Average quality was determined, using the isokinetic data plus nine-rod air–water data. At average channel qualities of 15% the quality in Subchannel No. 1 under adiabatic conditions is much lower than the channel average; under boiling conditions, it is close to the channel average. Two internally heated annulus correlations were used to predict the critical heat flux, based on conditions in the corner subchannel. This appears to be a promising procedure for predicting critical heat flux in a multirod array.
Author (NSA)

N67-33434# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TRANSITION BOILING HEAT TRANSFER PROGRAM Quarterly Progress Report, Oct.–Dec. 1966
3 Jan. 1967 29 p refs
(Contract AT(04-3)-189)
(GEAP-5426; EURAEC-1792; QPR-16) CFSTI: HC $3.00/MF $0.65

The series tests with the tube test section were performed at 1000 psia with mass velocities of 0.5 and 0.75 million lb/h-ft^2. Fully-developed film boiling coefficients were measured, along with steam phase temperatures, using a special temperature probe. The probe data demonstrated quantitatively that the steam phase was superheated for heat transfer from a dry wall to a flowing steam–water mixture. A new single-rod annular test section has been designed for obtaining fully-developed heat transfer coefficients and bulk steam phase temperature measurements. The design incorporates small profile spacers, 18-inch spans between spacers, and special construction for attaining higher heated wall temperatures than previously possible.
Author (NSA)

N67-33449*# Dynamic Science Corp., Monrovia, Calif.
INVESTIGATION OF THE FLAME STRUCTURE OF A THERMALLY UNSTABLE FUEL Final Report
Stuart Hersh, B. R. Lawyer, R. J. Hoffman, and B. P. Breen 30 Jun. 1967 42 p refs
(Contract NAS7-442)
(NASA-CR-72261; DS-SN81B) CFSTI: HC $3.00/MF $0.65 CSCL 21B

An investigation of the hydrazine/nitrogen tetroxide droplet flame is reported. The results of the experimental work are the temperature and stable species concentration profiles. It is concluded that a hydrazine decomposition flame exists at the droplet surface causing a large temperature gradient which results in much higher burning rate than found for thermally stable fuels.
Author

N67-33459*# Oklahoma State Univ. Research Foundation, Stillwater. Coll. of Engineering.
EDUCATIONAL MONOGRAPH PREPARED FROM METHOD FOR ESTIMATING RATIO OF ABSORPTANCE TO EMITTANCE
J. A. Wiebelt Jan. 1967 18 p refs (See NASA-TN-D-2751)
(Contract NSR-37-002-045)
(NASA-CR-87322; HT-3-67) CSCL 20M

A graphical method is presented for estimating the values of the ratio of absorptance to emittance α/ϵ that can be achieved with surfaces having a high degree of spectral selectivity. The ratio of emitting source to absorbing surface temperature is the parameter in the graphs. In principle, the results of the calculations presented are general and apply for any source or surface temperature. In practice, the ratios of absorptance to emittance so estimated can be used in radiant heat transfer calculations involving space vehicles. In this case α becomes α_s, the total normal absorptance of a surface to solar radiation, and ϵ the total hemispherical emittance.
Author

N67-33537# Aktiebolaget Atomenergi, Stockholm (Sweden).
CALCULATION OF STEAM VOLUME FRACTION IN SUBCOOLED BOILING
S. Z. Rouhani Jun. 1967 32 p refs
(AE-286) CFSTI: HC $3.00/MF $0.65

An analysis of subcooled boiling is presented. It is assumed that heat is removed by vapor generation, heating of the liquid that replaces the detached bubbles, and to some extent by single phase heat transfer. Two regions of subcooled boiling are considered and a criterion is provided for obtaining the limiting value of subcooling between the two regions. Condensation of vapor in the subcooled liquid is analyzed and the relative velocity of vapor with respect to the liquid is neglected in these regions. The theoretical arguments result in some equations for the calculation of steam volume fraction and true liquid subcooling.
Author (ESRO)

N67-33538*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
THE VISCOSITY AND THERMAL CONDUCTIVITY COEFFICIENTS OF DILUTE NEON, KRYPTON, AND XENON
H. J. M. Hanley and G. E. Childs 23 Mar. 1967 31 p refs
(NASA Order R-06-006-046)
(NASA-CR-87416; NBS-TN-352) GPO: $0.25 CSCL 20M

The coefficients of viscosity and thermal conductivity for dilute neon, krypton, and xenon were examined by a method already proved successful for dilute argon, oxygen, and nitrogen. This method selects a suitable potential function, and its parameters, which is then used to correlate theory with experimental data, given the kinetic theory expressions for the transport coefficients. The method has recently been expanded and generalized and the results of this general study are applied in this note. The potential functions examined were members of the m-6, Kihara, Exp: 6, and Morse families. It was found that the Kihara was most suitable for krypton and xenon, respectively. Viscosity and thermal conductivities were calculated from these functions and tables are given between 100 and 1000°K.
Author

N67-33578# Bureau of Mines, Amarillo, Texas. Helium Research Center.
THERMODYNAMIC PROPERTIES OF A VAN DER WAALS FLUID IN THE TWO-PHASE REGION
Robert E. Barieau Jun. 1967 19B p refs
(BM-RI-6950)

General expressions for evaluating various thermodynamic properties applicable to the van der Waals equation of state have been derived. These formulas were subsequently used to evaluate various thermodynamic functions in the two-phase region. The results indicate that, for a van der Waals fluid, there is a finite discontinuity in the second derivative of the vapor pressure curve, in the second derivative of the chemical potential or Gibbs free energy at the critical point, and in the heat capacity at constant volume measured at the critical density. Numerical values are tabulated and graphs are presented for all functions calculated.
Author

N67-33691# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL DETERMINATION OF THE LAW OF HEAT EXCHANGE FOR THE TURBULENT BOUNDARY LAYER IN A SUPERSONIC FLOW [EKSPERIMENTAL'NOYE OPREDELENIYE ZAKONA TEPLOOBMENA DLYA TURBULENTNOGO POGRANICHNOGO SLOYA V SVERKHZVUKOVOM POTEKE]
L. V. Kozlov 23 Jan. 1967 20 p refs Transl. into ENGLISH from the book "Issledovaniye Teploobmena V Potokakh Zhidkosti i Gaza" Moscow, 1965 p 91–102
(FTD-HT-66-379; TT-67-62137; AD-653956) CFSTI: HC $3.00/MF $0.65

It is concluded that: (1) the nondimensional heat-transfer coefficient obtained through the use of flow parameters taken at the wall temperature depends on the temperature factor and only weakly on the Mach number; (2) the obtained empirical formulas are to be used for calculating heat transfer in the range of M, Re, and temperature values considered; (3) the empirical relationships expressed by local properties of the boundary layer are obtained, and may be regarded as complementary relations in the form of the heat transfer law in the integral equation of the boundary layer for a body of arbitrary shape with zero or negative gradients of velocity or temperature. TAB

N67-33700# Linde Div., Union Carbide Corp., Indianapolis, Ind.
RESEARCH AND DEVELOPMENT IN A THERMAL INSULATION STUDY Quarterly Progress Report, Jan.–Mar. 1967
W. D. De Witt 5 May 1967 48 p
(Contract AT(30-1)-3632)
(ALO-3632-14) CFSTI: HC$3.00/MF$0.65

Small scale processing tests were conducted on Cu flake opacified Refrasil quartz fiber paper, Astroquartz cloth, and Refrasil quartz fiber paper. This completes the planned processing experiments. Offgassing rates and gaseous compositions were determined for the following insulation materials: Al foil, Cu foil, Ni foil, Ta foil, glass fiber paper, Al flake opacified glass fiber paper, Refrasil quartz fiber paper, Cu flake opacified Refrasil quartz fiber paper, Astroquartz cloth. A sample getter requirement calculation is presented. This completes the planned offgassing study. Thermal conductivity data is presented for the copper foil–Refrasil quartz fiber paper composite and the Ta foil–Astroquartz cloth composite. The Cu foil–Refrasil quartz fiber paper composite has completed 1,750 hours of a scheduled 2000 thermal performance test at 1260°F with no degradation of thermal performance. A Cu foil–copper flake opacified Refrasil quartz fiber paper composite has been installed on a thermal conductivity tester and testing will be initiated in the next reporting period. A Ni foil–Refrasil quartz fiber paper composite is being installed on a thermal conductivity tester. The vacuum enclosure-insulation materials compatibility test apparatus and the second vacuum enclosure test specimen, Hastelloy-X, were assembled. A 2000 hour test was initiated during the period. Author (NSA)

N67-33710# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THERMODYNAMICS OF TWO-PHASE DIABATIC FLOW AND RELATED INSTABILITIES
Giuseppe Basso 1966 31 p ref
(RT/ING/(66)/20)

The analysis is limited to flow with an intense heat addition in which the kinetic energy of the fluid degraded to heat, owing to internal friction, can be neglected when compared with heat input. It is concluded that burnout related to hydrodynamic instability can occur only during transition to annular flow when the liquid film becomes fairly independent of the central foggy core. NSA

N67-33774# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF CATALYTIC RECOMBINATION OF HEAT TRANSFER IN A "FROZEN" TURBULENT BOUNDARY LAYER
U. V. Lapin *In its* Leningrad. Politech. Inst. Trans. 5 Dec. 1966 p 33–41 refs (See N67-33770 19-12)

Previous investigations on the heat transfer in a dissociating gas are extended to include the catalytic effect on the flow of a turbulent layer near the plate at an arbitrary recombination rate. The study is based on laminar sublayer and turbulent core system, and the Prandtl and Schmidt numbers are taken equal to unity. The fundamental equations for velocity, continuity, and energy and mass transfer for the core and the sublayer are presented. The approximate connection of the total enthalpy and concentration profiles with the velocity profile is established. The friction and heat transfer are computed, and it is shown that the catalytic capacity of the walls has considerable effect on the magnitude of the heat flow to the wall. N.E.N.

N67-33836*# Oklahoma State Univ., Stillwater. Coll. of Engineering.
EDUCATIONAL MONOGRAPH CRITICAL FLOW OF REAL GASES THROUGH NOZZLES PREPARED FROM REAL-GAS EFFECTS IN CRITICAL-FLOW NOZZLES AND TABULATED THERMODYNAMIC PROPERTIES
W. C. Edmister Feb. 1967 53 p refs See NASA-TN-D-2565
(Contract NSR-37-002-045)
(NASA-CR-87318; TD-3-67) CSCL 20D

Methods for calculating the mass flow of real gases through critical-flow nozzles are presented by: (1) equation derivations for the entropy–enthalpy balances and the isentropic–exponent methods, (2) tabulations of thermodynamic properties for critical-flow conditions of steam, (3) problem on application of tabulated data in thrust calculation, and (4) problem on evaluation of thermodynamic critical-flow properties of fluids represented by the Redlich–Kwong Equation of State. Author

N67-33864*# Scientific Translation Service, La Canada, Calif.
STUDY OF THE PROCESS OF HEAT AND MASS TRANSFER DURING THE EVAPORATION OF A LIQUID WITH A FREE SURFACE IN A RAREFIED GAS MEDIUM [ISSLEDOVANIYE PROTSESSA TEPLO- I MASSOBMENA PRI ISPARENII ZHIDKOSTI S OTKRYTOY POVERKHNOSTI V RAZREZHENNOY GASOVOY SREDE]
V. I. Balakhonova Washington, NASA, Jul. 1967 8 p Transl. into ENGLISH from Inzh-Fiz Zh. (Moscow), v. 12, no. 1, 1967 p 3–9
(Contract NASw-1496)
(NASA-TT-F-11151) CSCL 20M

Results of simultaneous heat and mass transfer measurements during stationary adiabatic vaporization of water, ethyl alcohol, and carbon tetrachloride at pressures from 1×10^{5} to 1.33×10^{3} newton/m^2. The lowest temperature was established on the surface of the liquid and the coefficient of convective heat transfer was found to be a function of pressure, temperature, thermal pressure, and direction of the thermal flux. Author

N67-33878# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
THERMOPHYSICAL PROPERTIES OF SOME MULTILAYER INSULATIONS IN CRYOGENIC TEMPERATURES [TEPLOFIZICHESKIE SVOISTVA NEKOTORYKH MNOGOSLOINYKH IZOLYATSII PRI KRIOGENNYKH TEMPERATURAKH]
L. B. Golovanov 1967 21 p In RUSSIAN
(JINR-P8-3237)

The thermal conductivity coefficients for a number of multilayer insulations are given. The dependence of the value of the thermal conductivity coefficient on the pressure in the insulation space, at different compression of insulation, was found. The coefficient of thermal conductivity was determined at the boundary temperatures 293 to 77.6°K, 293 to 20.4°K, and 293 to 4°K. The insulation was pressed from 1 g/cm^2 up to 1000 g/cm^2. The pressure in insulation space varied from 1×10^{-5} to 1×10^{-1} mm Hg. Author (NSA)

N67-33879# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
SINGULARITIES OF MEASURING THE COEFFICIENTS OF THERMAL CONDUCTIVITY OF MULTILAYER INSULATIONS [OSOBENNOSTI IZMERENIYA KOEFFITSIENTOV TEPLOPROVODNOSTI MNOGOSLOINYKH IZOLYATSII]
L. B. Golovanov 1967 21 p In RUSSIAN
(JINR-P8-3236)

The influence of the background effect, nitrogen concentration, para-hydrogen concentration, and a number of other factors on the accuracy of determining the coefficient of thermal conductivity at the boundary temperatures 293 to 77.6°K, 293 to 20.4°K, and 293 to 4°K was found. Measuring of the heat flux, both by the quantity of the liquid vaporized and by the heater power, made it possible to estimate the effect of the heat flux, appearing at the heat exchange between the sample of the insulation investigated and the medium (edge effect), on the measurement results. Attempts were made to diminish the edge effect and to determine the errors due to this effect, while determining the coefficient of thermal conductivity of the insulation. Author (NSA)

N67-33883# Groningen Rijksuniversiteit (Netherlands). Mathematisch Instituut.
ONE-SPEED TRANSPORT THEORY WITH ANISOTROPIC SCATTERING. APPLICATION TO THE SLAB ALBEDO PROBLEM. PART I: THEORY
H. G. Kaper Jul. 1966 76 p refs
(NP-16508; TW-37, Pt.I) Pt. I)

The method for solving one-speed transport problems with anisotropic scattering in plane geometry as developed by Mika is applied to the slab albedo problem, i.e., the problem of finding the angular density of particles in a bare slab with a monoangular beam of particle incident upon one face. The problem is reduced to determining coefficients in the so-called normal mode expansion. These coefficients are shown to depend upon the solution of a set of nonhomogeneous Fredholm integral equations. Author (NSA)

N67-33900# Technische Hochschule Stuttgart (West Germany). Institut fuer Verfahrenstechnik und Dampfkesselwesen.
EXPERIMENTS FOR SIMULATING HEAT TRANSFER FROM THE REACTOR SURFACE TO THERMIONIC CONVERTERS [VERSUCHE ZUR SIMULIERUNG DER WAERMEUEBERTRAGUNG VON DER REAKTOROBERFLAECHE AN THERMIONISCHE KONVERTER]
A. Koeppe Bad Godesberg, W. Germany, Bundesmin. fuer Wiss. Forschung, Jan. 1967 28 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-08)

Experiments for simulating heat transfer by radiation from the reactor surface to thermionic converters are described. Preliminary investigations on the temperature distribution of heated plates were carried out. In order to get a suitable contact potential difference for the operation of the converter the plates were plated. The operation, as a noble gas converter, with an auxiliary electrode is described. The measured current-voltage-characteristic is discussed. A cesium diode for a SRAST-system was built and is described. Author (NSA)

N67-33911# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.
CRYOGENIC PROPERTIES OF HELIUM-3 AND HELIUM-4
B. Colyer Nov. 1966 41 p refs
(RHEL/R-136) HMSO: 5s 6d

Data on the properties of liquid and gaseous ^3He and ^4He were correlated. Values of thermal conductivity integrals for constructional materials were calculated and extrapolated down to 1°K. The results are presented as graphs. Author (NSA)

N67-33928# California Univ., Berkeley. Lawrence Radiation Lab.
A NEW HYDRODYNAMIC LIQUID COOLING METHOD FOR EDGE-COOLED, FLAT CONDUCTOR MAGNET COILS AND FOR LIQUID-COOLED FERRITE RF RESONATOR DISCS
John G. Dorward 22 Feb. 1967 7 p Presented at the Natl. Particle Accelerator Conf., Washington, 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-17275; CONF-670307-35) CFSTI: HC $3.00/MF $0.65

A method of efficiently cooling tape-wound, edge-cooled magnet coils, or ferrite discs results from the action of an inwardly-directed spiral free vortex flow pattern of the coolant. Many of the unfavorable hydraulic losses and heat-transfer limitations inherent in conventional internally-cooled magnet coils can be eliminated or minimized. The designer can independently control fluid velocities, turbulence, heat-transfer rate, fluid flow rate, bulk temperature rise, and coil space factor within wide limits by the use of hydrodynamic techniques. Hydraulic pumping energy can be minimized, conductor temperature rise can be reduced, and in many cases, the electrical current density in the conductors can be raised by the use of external vortex coolant flow. The radial increase of fluid velocity toward the center matches the need for improved cooling of the inner portions of RF ferrite discs resulting from the increased heating at the inner rim. This reduces the hazard of thermal fracture in the brittle ferrite due to differential heating. Author (NSA)

N67-33934* Scientific Translation Service, La Canada, Calif.
CONVECTIVE HEAT TRANSFER IN CURVILINEAR SHORT CHANNELS [KONVEKTIVNYY TEPLOOBMEN V KOROTKIKH KRIVOLINEYNYKH KANALAKH]
V. K. Shchukin and V. A. Filin Washington, NASA, Jul. 1967 9 p refs Transl. into ENGLISH from Inzh.-Fiz. Ah. (Moscow), v. 12, no. 2, 1967 p 169–176
(Contract NASw-1496)
(NASA-TT-F-11152) CSCL 20M

Experimental measurement of the convective heat transfer for a flow of water in a channel with a 49-mm cross section and a radius of curvature of 150 mm. The temperature of the flow was 18° to 35°C, that of the walls varied from 25° to 60°C, and the flow rate was from 0.00167 to 0.351 m/sec. Measurements of the heat transfer coefficient at the convex, concave, and plane sections of the channel by the gradient method revealed the presence of a section with eddied laminar flow, a section with mixed mechanical and thermal convection, and a section with purely thermal convection. The correctness of the formulas used in heat transfer measurements is discussed, and the analytical and experimental results are compared. Author

N67-33960*# Oklahoma State Univ., Stillwater.
EDUCATIONAL MONOGRAPH PREPARED FROM FORMULAS FOR RADIANT HEAT TRANSFER BETWEEN NONGRAY PARALLEL PLATES OF POLISHED REFRACTORY METALS
J. A. Wiebelt Jan. 1967 25 p refs
(Contract NSR-37-002-045)
(NASA-CR-87255; NASA-TN-D-2902) CSCL 20M

Hemispherical emittance, both total and spectral were calculated from normal spectral-emittance data. The metals evaluated were clean polished tungsten, molybdenum, and tantalum, each of which exhibits spectral emittances that vary considerably with temperature and wavelength. Net radiant heat flow between two parallel infinite plates was computed by summing the monochromatic energy exchange. The evaluation was made for all nine possible combinations obtained by interchanging metals on the two surfaces. The results are graphically presented as a function of temperature of the two surfaces. Equations of the form $q = a(T_1^b - T_2^b)(T_a/T_1)^c$ were fitted to each of the nine sets of heat flux calculations, where q is the heat transfer rate and T_1 and T_2 are the temperature

of the hotter and cooler surfaces, respectively. Values of the constants, a, b, and c are presented along with contour plots showing the temperature regions in which the equations are accurate. A comparison with conventional calculation techniques is presented.
Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-32974*# Southeastern State Coll., Durant, Okla. Technology Use Studies Center.
[PROGRAM TO ENHANCE THE TRANSFER OF NEW TECHNOLOGY TO POTENTIAL INDUSTRIAL, GOVERNMENTAL AND ACADEMIC USERS IN THE OKLAHOMA AREAS] Quarterly Status Report, 1 Apr.–30 Jun. 1967
Lee B. Zink Jul. 1967 20 p
(Contract NSR-37-004-006)
(NASA-CR-87305; QSR-9) CFSTI: HC $3.00/MF $0.65 CSCL 05A

Technology utilization projects in the Oklahoma area are reported. Brief discussions are presented on current status of the peanut drying project, aluminum brazing, motor oils evaluation, solvents for cleaning metal surfaces, incinerator materials, plastic resins, kiln drying, joining methods for steels, and welding. S.P.

N67-33018*# North Carolina Science and Technology Research Center, Raleigh.
THREE SPECIAL EXPERIMENTAL PROJECTS IN TECHNOLOGY UTILIZATION Quarterly Progress Report, Apr. 1–Jun. 30, 1967
Edward W. Erickson and P. J. Chenery Jun. 1967 11 p
(Contract NSR-34-007-005)
(NASA-CR-87303; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 05B

Preliminary planning to conduct a pilot project measuring the benefits that may have accrued to industry clients and the State of North Carolina from operation of a regional dissemination center for new technology is explained. The Center's applications engineers evaluated titles of master's theses from N. C. State University to determine if they contain technology potentially useful for industry. Pretesting of plans to furnish economical computer searches to qualified students undertaking thesis and dissertation research at the State's universities and colleges was conducted.
Author

N67-33183# Oak Ridge National Lab., Tenn.
CRITICAL PATH TIME-COST SCHEDULING FOR MANAGEMENT OF RESEARCH AND DEVELOPMENT PROJECTS
W. W. Goolsby and F. T. Snyder May 1967 65 p refs
(Contract W-7405-ENG-26)
(ORNL-4112) CFSTI: HC $3.00/MF $0.65

A method of managing research and development projects that incorporates a system of cost control with critical path scheduling has been developed at Oak Ridge National Laboratory, and the method is currently being used on selected projects at the Laboratory. This method serves the needs of the project managers in planning, analyzing, and controlling projects from their inception through their completion. Designed as a general-purpose system that makes maximum use of the automated processing of information, the scheduling system permits management to obtain a coordinated set of time and resource schedules with the option of resource leveling. The cost system uses the information generated by the scheduling system to collect and report detailed costs for labor, material, and equipment. The actual expenditures of time, manpower, and dollars are then compared with the estimated expenditures and the scheduled progress. The development of this time-cost method of project management at Oak Ridge National Laboratory is discussed in this report, and the functions of the scheduling and cost systems, the input requirements for the computer programs, the computer reports, and the options available are described.
Author (NSA)

N67-33361*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
RESEARCH AND DEVELOPMENT PROGRAMS Quarterly Report, Jan.–Mar. 1967
Mar. 1967 63 p refs
(NASA Order R-76; Contract NOw-62-0604-c)
(NASA-CR-87061; U-RQR-67-1) CFSTI: HC $3.00/MF $0.65 CSCL 20

Articles on current research and exploratory development, fundamental research, and DOD research projects at the Applied Physics Lab. are presented. For individual titles see N67-33362–N67-33391.

N67-33400*# National Aeronautics and Space Administration, Washington, D. C.
ELEMENTS OF DESIGN REVIEW FOR SPACE SYSTEMS
R. E. Boss and C. H. Mc Gaffin (Martin Co., Baltimore, Md.) 1967 62 p refs
(Contract NASw-1128)
(NASA-SP-6502) CFSTI: HC $3.00/MF $0.65 CSCL 14A

Design reviews performed by space system contractors are detailed, along with some of the reviews and tradeoffs conducted by the customer to satisfy overall program requirements. Detailed objectives of the design review are concerned with evaluating design capability in terms of total system requirements; identifying process control, production, and procurement problems; determining if design conforms to the specifications required for operational use; and optimizing design within functional performance requirements. Elements of a design review are review team makeup and responsibilities, customer participation, frequency of review, data inputs and outputs, and continuity and followup procedures. Review categories discussed deal with preliminary design, prepackaging and pre-release design, acceptance, and special purpose reviews. Applications and costs of design review for space systems are also included in this manual intended as an aid for instructing technically trained personnel in design review implementation and evaluation.
M.W.R.

N67-33428# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY, EXPERIMENT OF PRACTICE
P. L. Kapitsa 13 Feb. 1967 64 p Transl. into ENGLISH of the book "Teoriya, Eksperiment. Praktika" Moscow, Izd. Znaniye, 1966 p 1–48
(FTD-MT-67-17; AD-653681) CFSTI: HC $3.00/MF $0.65

Contents: The scope of scientific work and the role of the Scientist-organizer; Assimilating (Mastering) the achievements of science and technology; Theory, experiment and practice; The unity of science and technology; The efficiency of scientific work; Questions about the organization of scientific work; The Institute of physical problems.
TAB

N67-33944# Oak Ridge National Lab., Tenn.
A SYSTEM FOR BIOMEDICAL DATA MANAGEMENT (DATASYS). PART V: BIORPG
Diane B. Smith Jan. 1967 18 p
(Contract W-7405-ENG-26)
(ORNL-TM-1693, Pt. 5) CFSTI: HC $3.00/MF $0.65

BIORPG allows the user to generate reports directly from data files. Headings, footings, spacing, and the lines per page may be designated by control statements. BIORPG can be used conveniently with other DATASYS modules to list selective data in almost any prescribed format. Author (NSA)

N67-33993*# North Carolina Science and Technology Research Center, Durham.
REGIONAL TECHNOLOGY TRANSFER PROGRAM Quarterly Progress Report, 1 Apr. 1967–30 Jun. 1967
30 Jun. 1967 31 p refs
(Contract NSR-34-007-003)
(NASA-CR-87309; QPR-12) CSCL 05B

Computer searches were provided to 45 regular subscribers and to five other agencies, including two firms, two universities and one research institute. An automated vendor catalogue library was added to this regional dissemenation center. A symposium to bring new technology developed by universities and industry to the attention of potential user companies drew wide attendance. Four cases of potential or actual transfer of technology are reported. Efforts will continue to obtain computerized files of chemical and textile literature. Author

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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